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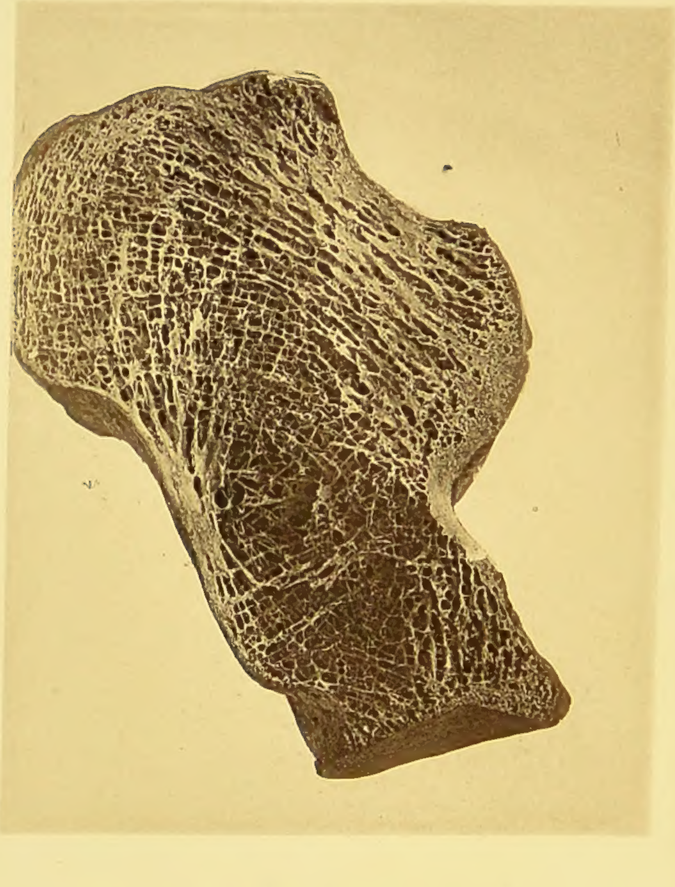
ON THE

OPERATIVE SURGERY

OF THE

FOOT AND ANKLE-JOINT



ON THE

OPERATIVE SURGERY

OF THE

FOOT AND ANKLE-JOINT

BY

HENRY HANCOCK

PRESIDENT OF THE ROYAL COLLEGE OF SURGEONS OF ENGLAND, CONSULTING SURGEON
TO THE CHARING CROSS HOSPITAL, ETC.

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PREFACE.

In presenting these Lectures, delivered at the Royal College of Surgeons during the years 1865–6, with additions bringing them down to the present time, I beg most heartily to thank the numerous friends who have so kindly placed their cases, drawings, &c., at my disposal; as also my colleagues, Dr. Silver and Mr. Bellamy, for their valuable assistance in preparing them for the press.

76, Harley Street,
1st *March*, 1873.

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ANATOMY AND SURGERY OF THE HUMAN FOOT.

LECTURE I.

Mr. President and Gentlemen,

The appointment to which you, Sir, and the Council of this College, have done me the honour to elect me brings forcibly to my recollection an incident which I observed during the summer of last year. Strolling in a park in the country, I inadvertently disturbed the tumulus of an ant's nest. For a moment there was great commotion, but almost as quickly each little active insect set itself to work to repair the mischief I had caused. Some, the giants of the tribe, dragged or pushed (to them) great beams in the shape of twigs, others conveyed the spikes of the fir-tree, whilst others again contented themselves with a mere granule of sand; but all worked with one accord for the general good towards the repair and completion of their common home.

The illustrious men who have preceded me in this chair have, like the giant ants, contributed the great beams of their experience and learning, the invaluable results of their energy and talents, to the edification and improvement of ourselves and future ages. I, alas! can only hope to contribute my granule of sand; but, minute as my offering may be, let me hope that it may in some degree tend to "the progress and improvement of practical surgery."

I feel that in the performance of the duties which devolve upon me, I cannot do better than continue the subject so ably treated by my immediate and distinguished predecessor, Sir William Fergusson—namely, the Progress of Surgery during the last Century; and for this purpose I have selected the Anatomy and Surgery of the Human Foot and Ankle-joint as the subject-matter of this and the following lectures.

Probably in no other part of the human body has surgery made greater strides during the last thirty or forty years than in the foot; but great as its progress has been, it still offers scope for further improvement by the removal of erroneous views, which have hitherto, to a greater or less extent, exerted a prejudicial influence over the minds of Surgeons.

The anatomy of the foot, regarded by the light of purely descriptive anatomy as set forth in most standard anatomical works, offers, it must be confessed, but few charms to the student. Its complicated skeleton, made up of numerous bones of almost indescribable shapes; its various joints, with their connecting ligaments; and its numerous muscles, especially in the sole of the foot, with their tendons running and crossing each other in all directions,—render it, when considered abstractedly, a very difficult and unenticing study. But when, having conquered these dry details, the surgeon regards this apparently intricate and difficult piece of mechanism in relation to its functions and the consequent surgery of the part, the aspect of the picture unfolded to his view becomes instantly changed. That which was his former bane becomes his present delight; until at length, from contemplating the comprehensiveness of design, the ingenuity and at the same time simplicity, the wondrous adaptation of the several parts to their several functions, and withal the perfection and completeness of each individual part in itself, he cannot but feel the great responsibility which he undertakes in practising the surgery of the foot, and the impropriety—I am almost tempted to say sin—of unduly sacrificing any portion thereof.

Would that I had the genius of a Charles Bell—his artistic hand to delineate, his graphic mind to make clear, the many and beautiful points of physiological interest connected with this organ. We of the present age look around us with surprise and admiration at what is being done in all directions. We, as a nation, are proud, and justly proud, of the skill of our Engineers—of the wonders they have achieved, and the eminence to which they have attained. We are proud of our bridges crossing the several rivers; we are proud of the bridge across the Menai Straits, and of the stupendous viaducts which span the valleys in all parts of the country. But vast and wonderful as are these examples of human skill, they dwarf into insignificance when compared with this small organ which we are now considering. *They* have merely to sustain weights; where *they* are placed there they must remain; *they* possess no motor power; *they* have no power of locomotion. But how manifold are the functions with which the human foot is endowed! Man is ordained to maintain the erect position. He has to toil, to carry weights and to draw weights. As lord of the creation he has to govern and subdue the whole animal kingdom, and to till the ground; he has to walk, run, jump, leap, or vault, climb, &c. Upon the foot does he depend for the performance of these several duties. However hard the labour, whatever the weight to be carried or drawn—whatever the distance to be walked or run—whatever the depth to be jumped, the space to be leaped, or the height to be climbed, the foot has in addition and always to sustain the superimposed human frame; not as a mere solid immovable mass, but with a fostering though firm elasticity, without which these several actions could never be performed, save with an amount of jarring and concussion that would inevitably destroy the delicate organs of the body, such as the brain, spinal marrow, &c. In the whole range of mechanics, architecture, or engineering, where can we meet with a structure such as this?

The skeleton of the foot in man is composed of twenty-eight bones: seven tarsal, five metatarsal, fourteen phalangeal, and two sesamoid bones.

The tarsal bones are short and spongy. They form the heel of the foot; enter into the ankle-joint and instep; constitute the principal arches of the foot; and consist of the os calcis or heel bone, the astragalus or ankle bone, the scaphoid, the three cuneiform, and the cuboid bones.

The metatarsal are long bones, situate intermediately between the tarsal behind, and the phalangeal in front. They complete the longitudinal arch of the foot anteriorly, and give support to the phalanges which constitute the toes.

The phalanges are fourteen in number, each of the four outer toes being provided with three, whilst the inner or great toe has only two—an arrangement which obtains throughout the whole class of mammalia, wherein, however numerous the phalanges of the other toes may be, those of the great toe never exceed two, although they may be increased in length to compensate for their paucity in number.

It is very difficult to give a clear and at the same time concise description of the arrangement of these bones. Dr. Cross divides them into two unequal longitudinal series, an internal and external; the former being much the larger of the two, the internal commencing with the astragalus, the external with the os calcis. Professor Humphry, although to a certain degree recognising this arrangement, institutes three series: a posterior, comprehending the os calcis and astragalus; and an internal and an external anterior series, comprising the remainder of the bones included in Cross's arrangement. Mr. Bishop, on the other hand, recognises, like Cross, only two series: an internal and an external. But he differs from this gentleman in making the os calcis common to both.

Inasmuch as, for the purpose of completing the skeleton of the foot, and considering its functions, we must connect the os calcis and astragalus with the other tarsal bones, I prefer the arrangement of Bishop to either that of Cross or Humphry, as being more simple and more readily understood, and withal more in accordance with the functions of the part. According to this gentleman the two series are arranged thus, from behind forwards.

Internal.

Os calcis.
Astragalus.
Scaphoid.
Three cuneiform.
Three internal metatarsal bones.
Eight phalanges.

To which we may add the two sesamoid bones.

External.

Os calcis.
Cuboid.
Two external metatarsal bones.
Six phalanges.

The foot, as a whole, presents two surfaces—a "superior" and an "inferior;" two extremities—an "anterior" and a "posterior;" and two margins or edges—an "internal" and an "external."

The superior or dorsal surface is convex in the antero-posterior direction, and also from side to side. The convexity in the latter direction is most developed over the cuneiform and cuboid bones, and constitutes the transverse arch of the foot, its aspect being upwards and outwards, the inner extremity of the arch being about an inch higher than the outer one. The antero-posterior arch rests in front upon the rounded distal extremities of the four external metatarsal bones, and on the two sesamoid bones articulated to the under surface of the larger first metatarsal bone at its distal extremity. Behind, the posterior extremity or tuberosity of the os calcis constitutes its basis of support. The two constitute the arches of the foot; and upon them depend not only its strength, but also its elasticity.

The inferior surface, very irregular, presents the concavities of the two arches already alluded to. The external margin, in standing, rests for the most part upon the ground. The internal margin presents points of the greatest interest. We have here the longitudinal arch of the foot. We have here, also, two ball-and-socket joints, which, whilst they allow the bones entering therein a considerable degree of motion, at the same time, from their peculiar construction, endow the foot with that elasticity so all-important in the animal economy, and to which I have already directed your attention. These two joints are respectively the medio-tarsal or astragalo-scaphoid, and the internal metatarso-phalangeal joint of the great toe.

If you cast your eyes over the internal margin of the skeleton of the foot, you observe an interval between the os calcis and the scaphoid. This is filled up or completed by the calcaneo-scaphoid or round ligament, which, endowed with a considerable amount of elasticity, yields to a certain degree under any weight either suddenly or gradually thrown upon it, and thus deadens shocks and jars. Although not so given by anatomical writers, this ligament, as first described by myself in the year

1845, sends up an extension on the inner side of the foot and completes the socket of the joint in this direction; the importance of this arrangement will be seen hereafter.

Again, in the metatarso-phalangeal joint of the great toe is another ball-and-socket joint, as well as an especial provision against the effects of jars.

If we lay the metatarso-phalangeal joint open from above we find the sesamoid bones united by a strong intervening elastic ligament, upon which the anterior extremity of the metatarsal bone rests; and here we may also observe the uses of the sesamoid bones and the beauty of their arrangement. The first metatarsal bone, although considerably stronger, is shorter than the second, and were it not for the sesamoid bones it would drop below the level of the second metatarsal, which, too slight for the task, would then have to sustain the weight of the body and the various shocks from it. Situated, however, beneath its head, the sesamoid bones sustain the first metatarsal in its proper place and enable it to perform its allotted duties. And with regard to the beauty of the arrangement it must be borne in mind that this joint, unlike the medio-tarsal, has to sustain shocks at various angles according to the irregularities of the ground upon which it alights; so that whilst in the latter the ligament or spring is inserted into fixed points, in the former it is attached to two moveable bones (the sesamoid), which, in their turn, are connected with muscles especially appointed to regulate and accommodate their movements to the varying requirements and positions of the joint.

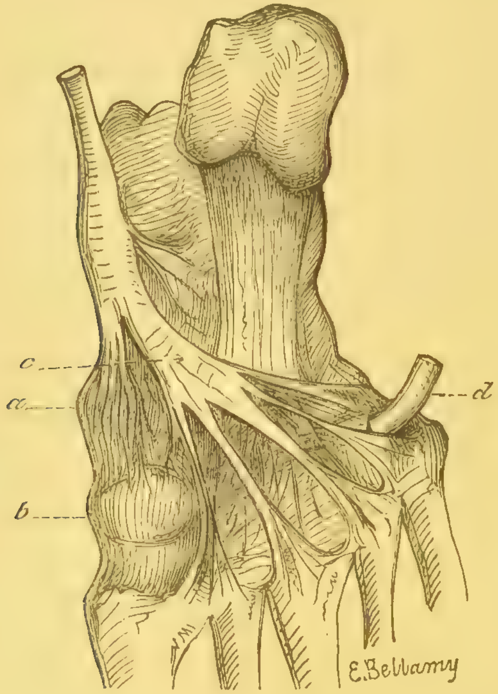
Now let us see how the arches of the foot are preserved. The antero-posterior or longitudinal having to support the weight of the body under all circumstances when the latter is in the erect position, the numerous bones of which the arch is composed, the shapes of their articulating surfaces, and the degree of motion allowed to their joints, all show that some extraneous aid is necessary to maintain the arch when called upon to perform its functions. Professor Humphry attributes this aid to the strong ligaments passing from bone to bone, regulating and limiting their movements, and especially to the strong plantar fascia and calcaneo-scaphoid ligaments. Doubtless, these ligaments do in some measure maintain the shape of the arch whilst in a quiescent state; but I very much question whether they possess sufficient elasticity or contractile power to accommodate themselves to the various requirements of the part. In the first place, the arch has to be made to stand fast and upright under the influence of the pressure of the body; and as regards the bones and ligaments, nothing can be more unfavourable. The rounded heel process, the overhanging astragalus, and the weight of the body pressing downwards and inwards upon the astragalus, all militate against its ability to do so. The ligaments, it is true, limit antero-posterior expansion, but they can have no influence over the preservation of the arch in the upright position. If solely dependent upon them, the foot would inevitably roll over when pressure was exerted upon the astragalus, or, in other words, when the body was in the erect position. Again, do these ligaments possess in themselves such an amount of contractile power combined with elasticity as to admit of their yielding sufficiently to deaden or counteract shock, and subsequently to resume the amount of rigidity necessary to maintain the integrity of the arch? And, lastly, in running or walking, when the arch has to depend upon its anterior pillar, could the strong plantar fascia exert the active force or cohesive power necessary to plant and maintain the front of the foot firmly upon the ground?

Mr. Barwell, in the year 1860, pointed out the importance of the tibialis anticus muscle in preserving the arch in the erect position of the body; but the tibialis posticus and flexor communis digitorum, which pass from the back of the leg under the sustentaculum tali, must not only assist in maintaining the arch, but must also prevent its inversion under the circumstances here alluded to. In walking, the heel first comes to the ground, then the head of the fifth metatarsal bone, and subsequently the remainder, in rapid succession, until the body is, as it were, turned over to and rests upon the sesamoid bones of the great toe, the toes themselves being left free to enable the foot to spurn the ground for the purpose of taking another step. In these movements the anterior pillar of the arch has, through the distal extremities of the metatarsal bones, to be brought to and fixed upon the ground; and this is effected by the four lumbricales muscles attached to the inner or tibial side of the distal extremities of the four outer metatarsal bones, assisted probably by the abductor and flexor brevis minimi digiti inserted into the outer or fibular side of the base of the first phalanx; and by the so-called abductor and adductor, as well as the flexor brevis and pollicis muscles, inserted into the sesamoid bones and base of the first phalanx of the great toe.

But whilst these muscles principally influence the longitudinal arch and the internal series of bones, the external series and transverse arch are not uncared for. For these, provision is made in the arrangement of the tendons of the peroneus brevis and longus. The former, passing behind and beneath the external malleolus, is inserted into the base of the fifth metatarsal bone, thus bracing up the calcaneo-cuboid and cuboido-metatarsal joints; and the latter, passing through the same groove behind the external malleolus, and then along the outside of the os calcis and cuboid, turns sharply on itself, enters a groove on the under surface of the cuboid bone, and, traversing the under surfaces of the three cuneiform bones, is inserted on the tarsal end of the metatarsal bone of the great toe. The tendon consequently describes two acute curves or angles, the first between the external malleolus and the cuboid, and the second between the cuboid and its insertion. In the latter course, it preserves the transverse arch, bracing the three cuneiform and the cuboid bones together; but being exposed to displacement from the acuteness of its angle, provision is made against this accident by the prominence of the margin of the cuboidal groove behind, and the attachment of the adductor pollicis and flexor brevis minimi digiti in front.

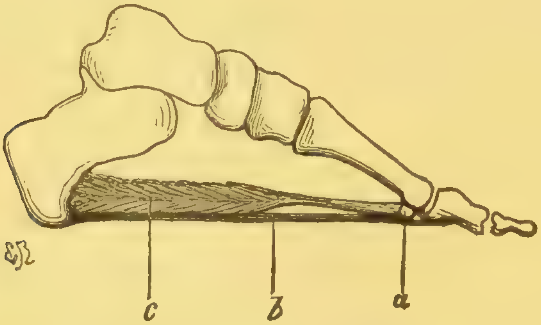
The transverse arch is sometimes strengthened by a peculiar distribution of the tendon of the tibialis posticus muscle, which, in addition to its insertion into the scaphoid and internal cuneiform, sends off a strong tendon diagonally across the foot to be inserted into the cuboid and base of the fifth metatarsal bone; and, as if to confirm the opinion which I have here expressed as to the assistance rendered by the adductor pollicis and flexor brevis minimi digiti muscles to the long peroneal tendon, this prolongation of the tibialis posticus gives off two diverticula, which pass for insertion to the bases of the second and third metatarsal bones, as may be seen in the annexed woodcut, taken from a preparation in the Museum of the College of Surgeons, dissected by Mr. Moseley.

Lastly, with regard to the other proposition—whether the long plantar ligament or fascia possesses in itself such an amount of contractile power combined with elasticity as to admit of its yielding sufficiently to deaden or counteract shock, and subsequently to resume the requisite amount of solidity or rigidity to enable it to maintain the integrity of the arch. To this we obtain a reply in the negative from the arrangement of parts, which shows that, after all, the influence exerted by this fascia over the longitudinal arch is passive and mediate, and neither active nor direct; indeed, it is very questionable whether its fibres are ever



(*a*) Insertion of tendon of tibialis posticus into scaphoid bone.
(*b*) Its insertion into internal cuneiform bone.
(*c*) Tendinous expansion dividing into five slips for insertion into the bases of all the toes.
(*d*) Tendon of the peroneus longus muscle.

stretched, or even extended, under pressure or shock, since especial care is taken to prevent their being so. The ligament does not pass straight across from point to point, but describes a curve the concavity of which looks downwards—corresponding, in fact, to the plantar arch; and this curve is preserved in the various positions of the foot by a very ingenious contrivance, and upon which the elasticity and at the same time firmness which is the perfection of walking mainly depend. The three muscles constituting the first layer of the muscles of the sole of the foot—the abductor pollicis, flexor brevis pedis, and abductor minimi digiti,—which serve, as we have seen, to fix the anterior pillar of the arch when the latter is subjected to pressure, have a very peculiar origin. They arise from bone —the inferior surface of the os calcis—by their upper surfaces, and from the long plantar ligament by their lower. This arrangement not only adds strength to the muscles by increasing their extent of attachment, but, through it, the muscles, when called into action, cannot exert their influence from before backwards upon the anterior pillar of the arch without at the same time acting from below upwards upon the plantar fascia, whereby the strength and tension of the latter, and at the same time its relation to the bony arch, are effectually preserved where otherwise they would be destroyed. The result of this arrangement is well seen in the foot of the dancer when moving about on the tips of the toes. Here the arch is not destroyed, but, on the contrary, is usually exaggerated—due, no doubt, to the great force which these muscles have to exert during this particular movement acting not only upon the anterior pillar of the arch, but at the same time upon the plantar fascia.*



(*a*) Sesamoid bone.
(*b*) Plantar fascia.
(*c*) Abductor pollicis muscle.

The foot is also described as being of a triangular shape, the base in front; and as resting upon three piers, one posterior and two anterior, the former constituted by the heel-bone, the latter by the anterior extremities of the two series already alluded to, or, more accurately speaking, upon the tuberosity of the os calcis behind, and the two sesamoid bones and the anterior extremity of the fifth metatarsal bone in front.

THE OS CALCIS.—The os calcis, or heel-bone, forms the great posterior pier of the bridge, and forms the entire posterior extremity of the foot. Oblong in shape, it presents six surfaces: Superior, inferior, anterior, posterior, external, and internal.

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* See Humphry, "Journal of Anatomy and Physiology," 1866, p. 187.

Its superior surface presents two articulating surfaces for the astragalus, the posterior—convex, broad, and directed forwards and outwards; the anterior—internal, narrow, and concave. These are separated by a deep rough transverse groove, fitted in the natural state by the strong interosseous calcaneo-astragaloid ligament. Behind the posterior articulating surface is a concave portion separating the latter from the insertion of the tendo Achillis.

The inferior surface broader behind than before presents posteriorly two tubercles (of which the inner is the largest), which give attachment to the plantar fascia and superficial plantar muscles. More anteriorly is another eminence for the attachment of the calcaneo-scaphoid ligament.

The anterior surface is the smallest; slightly concave, it articulates with the cuboid bone.

The posterior surface is convex, and inferiorly forms a rough projection (tuberosity of the os calcis) to which the tendo Achillis is attached. This projection is continued into the tubercles on the inferior surface of the bone. The upper part of the posterior surface is less prominent and smooth, and is separated from the tendo Achillis by a synovial bursa.

The external surface is nearly flat, and broader behind than before: anteriorly it is grooved for the tendons of the peronei muscles, and is otherwise subcutaneous throughout its extent.

The internal surface, deeply concave, gives transit to the posterior tibial vessels and nerves and to the tendons of the flexor muscles; anteriorly and superiorly is a prominent process (sustentaculum tali) grooved beneath for the tendon of the flexor longus pollicis, and concave above for supporting the astragalus.

Having thus briefly glanced at the descriptive anatomy of the bone, we will now consider its structure in relation to its uses—in other words, its mechanical or functional anatomy, commencing with its upper surface.

The shape, situation, and direction of the articulating surfaces for the astragalus are well worthy of attention. We might at first sight naturally conjecture that, being designed for the support of the astragalus, they would present a flat plane, looking directly upwards; instead of which there are two surfaces of unequal size, having different aspects, and separated from each other by the interosseous groove. The larger posterior and external articulating surface has its greatest diameter directed obliquely from above downwards, forwards, and outwards, to the outer extremity of the interosseous groove, and is convex in the same direction. Superiorly, this surface sweeps backwards and inwards to the inner extremity of the interosseous groove, forming with the "sustentaculum tali" a cup-like cavity, wherein rests the posterior portion of the astragalus. The anterior and internal surface is not above one-third the size of the former. It is shaped like an almond, concave from above downwards, looks upwards and forwards, and terminates inferiorly in a narrow slip of articulating surface prolonged forwards on to the internal superior margin of the great surface. This almond-shaped articulating surface forms the anterior surface of the "sustentaculum tali," and, with its prolongation, gives support to the astragalus.

This certainly appears to be a very complicated arrangement, but when studied in relation to its uses, its apparent complication and eccentricity at once disappear, and we find in their stead a simple and beautiful contrivance for the adaptation of parts to the functions which they have to perform.

The larger surface supports the body of the astragalus; the smaller, with its prolongation, the neck and to a certain extent the head of that bone. Upon the upper portion of the astragalus is the pulley, or trochlea, for sustaining the horizontal articulating surface of the lower end of the tibia, whereby the weight of the body is transferred to the former bone, and, through it, to the other bones of the tarsus.

I have already glanced at some of the functions of the foot. But it should be borne in mind that when called into action its chief employment, in addition to sustaining the weight of the body, is that of progression or walking; that in this employment it has frequently to support not the weight of the body only, but likewise any other burden which that body at the time being may have to sustain. The porter with his load, the coalheaver with his sack of coals, the miller with his sack of wheat, have all to be supported upon their feet equally with the most indolent and self-indulgent member of society; since, however small or however great the weight may be, if carried by man at all, it must be borne by the foot, and by that very part of the foot which we are now considering.

In walking, the heel is first planted on the ground, the toes being raised; the body is then swung forwards to the vertical position, the toes at the same time coming to the ground; and, lastly, the heel is raised so as to throw the weight of the body on to the other foot, swung forward to receive it. It is in these three movements, which very rapidly succeed each other, that we discover the object and value of the peculiar arrangement of the calcaneo-astragaloid articulation. During the first, and the transition into the second, the whole weight of the body is thrown upon the posterior calcaneo-astragaloid articulating surface, and consequently upon the heel-bone itself, which, in fact, becomes the means by which the power of the lever (tendo Achillis, tibialis posticus, flexor communis, and peroneus longus) overcomes the resistance of the body. If, therefore, the calcaneo-astragaloid joint were formed simply by the junction of two horizontal planes, its moment of trial would be its moment of weakness, and it would have to depend entirely upon the interosseous ligament. But as it is, when the toes are raised, the body of the astragalus rests entirely upon the body and tuberosity of the os calcis, so that the weight of the superimposed body and the great stress are referred directly to the os calcis at its widest and strongest part, which thus becomes firmly planted on the ground.

This arrangement exerts a direct and considerable influence over the transition from the second to the third movement in walking, assisting in no small degree the leverage exerted by the muscles already enumerated; for as the heel is raised, this surface, rising with it, is thrown forward, and, by pushing against the astragalus, assists materially in transferring the weight of the body from the heel to the balls of the great and its two outer toes; whilst the cup-like cavity at the upper extremity of this surface, with the consequent rising of its outer margin, together with the internal elevation of the sustentaculum tali, serve to keep the astragalus in its proper direction when labouring under its superimposed burden, and at the same time prevent the body of that bone from twisting outwards.

Nor are the ingenuity and importance of this external calcaneo-astragaloid articulating surface exhausted even yet. It has still to support the body in the third movement of walking—when the heel is raised, and the foot rests upon the anterior pier of its arch. The weight and pressure of the superimposed body are now to a great degree transferred from the os calcis to the astragalus, and, through it, the scaphoid, and three cuneiform bones, to the balls of the three internal toes. The same obtains, though with greater intensity, in jumping from a height; for, although modified to a certain extent by the bending of the knee, still here to the position of the joint we have the addition of the shock. And so likewise in the vaulting of the ballet girl across the stage, and still more so in that achievement wherein the dancer trips about the stage upon the tips of her toes, with the heels drawn directly upwards, the knee-joints fixed and unbent, and the legs consequently rigid and straight. In these and such-like movements the astragalus is placed at great disadvantage. It has to resist, not simply the weight of the body, but that weight thrown upon it with a sudden shock, and in an oblique direction. Hence the narrow portion of the tibio-fibular mortise, jammed against the wide anterior portion of the trochlear surface of the astragalus, forces the latter downwards and forwards upon the scaphoid bone. We must here remember that to enable it to withstand these disadvantages the astragalus has only the configuration and arrangement of the articulating surfaces of the os calcis whereon to depend. It has not a single muscle attached to it to brace it up or to give it support; and, indeed, in view of what it has to do, its ligaments even appear to be disproportionately weak.

Were there no especial arrangement by which the weight and force so referred to the balls of the three inner toes could be regulated and diminished, the heel could be planted on the ground, the foot might become horizontal, the heel might be raised from the ground, but there the power of progression would cease. The balls of the toes would be pressed upon the ground, but their comparatively weak extensor muscles would be quite unable to raise them, or to overcome the combined resistance of their opposing muscles and the weight of the body. Thus the completing movement of walking would be lost; whilst running, wherein the weight is throughout thrown upon the toes, could never be employed. But Nature has foreseen and guarded against this misfortune. She has taken care that the force and weight should not be unduly restricted to any one bone or spot, but should be so equably diffused as not to interfere with the free action of any individual part. We accordingly find that, even in this third movement of walking, the os calcis, though as it were suspended in the air, has not only to bear its own share, but it has to transmit a full proportion of this burden through the cuboid to the two external metatarsal bones; and this is effected by a very simple adaptation of means to an end—by a cohesion, as it were, between the astragalus and os calcis, or, in other words, a hooking on of the former upon the latter.

We have seen that the posterior external calcaneo-astragaloid articular surface is directed downwards, forwards, and outwards, and that it is convex in the same direction. By the prolongation of the upper extremity of this convex surface backwards, downwards, and inwards towards the sustentaculum tali, the semilunar or cup-like concavity between the former and the latter is formed. Upon this convex surface the astragalus is modelled by a nicely adjusted concavity, whilst, sending out a process at its posterior inferior and internal angle, it adapts itself to the cup-like concavity just described, becomes wedged in behind the sustentaculum tali, and thus, when the heel is raised, obtains not only a ligamentous (the interosseous), but also a firm bony support, the two bones as it were becoming one. The weight or force is by this contrivance equably diverted to the os calcis and the outer series or division of the foot, whilst the strain upon the distal extremities of the three internal metatarsal bones is still further diminished by the elasticity of the astragalo-scaphoid joint. Hence, whatever the degree of pressure, the force is so equably supported and diffused throughout the whole foot that these distal metatarsal extremities are in their turn enabled to bestow their burden upon the phalanges, which by their buoyancy and spring rapidly transfer it to the opposite foot.

In short, the posterior calcaneo-astragaloid articulating surface affords one of the many instances met with in animal mechanics of a part performing several, and those apparently opposite, offices. Here we find, in the first series of walking movements, this surface affording an entire basis of support; in the transition from the first to the third it is repellant or propulsive; whilst in the third it suspends the burden or weight, at the same time diffusing it throughout the rest of the foot.

The posterior extremity of the os calcis is, as we have seen, convex in all directions—an arrangement, doubtless, for facilitating the movement of the foot in walking. It is stated that in the higher orders of man the strength of the leverage is sacrificed to rapidity of motion, so that, whilst in the negro the heel is long, in the higher classes it is comparatively short. Professor Humphry, in his interesting little book, points out that the loss in the latter is compensated by increased development of the calf muscles, and that a high heel with a well-developed calf are best marked in nations endowed with the highest intelligence. That the calf may be regarded as a characteristic of man, and that a well-developed calf is a characteristic of the higher members of the human family, is an opinion which may or may not be correct; I can only hope that the absence of a well-developed calf does not of necessity place a man among the lower orders of his species.

Be this as it may, however, I would submit that the loss of power is not due either to the rapid descent or vertical direction of the heel-bone, but simply to the shortness of the projecting leverage portion behind the ankle. To say that the heel-bone in the higher races of mankind descends almost vertically is liable to mislead the student; for, in fact, the heel-process in Europeans, as in negroes, is only a prolongation (although in a minor degree) of the body of the os calcis backwards, whilst its apparently vertical descent is due to three causes: (*a*) the better developed plantar arch, and the consequently greater elevation of the anterior extremity of the bone to join the cuboid; (*b*) the shortness of the projecting heel-process compared with its vertical depth; and (*c*) by the bevelling off of the posterior inferior margin of the bone, by which the tubercles on its inferior surface are brought into bold relief. In considering this point, we should study the heel-bone in its entirety, and not by means of a longitudinal section of the foot, which gives this erroneous impression.

The loss of power, however, is compensated by the roundness or convexity of the posterior extremity of the os calcis allowing the foot to be thrown forwards with comparative ease, whilst additional force is given to the lever by the prolongation of the insertion of the tendo Achillis to the under part of the heel-process just behind the tubercles. By this arrangement a considerable increase of leverage is obtained. If the tendon were inserted simply into the upper margin of the heel-process, the lever would have to contend against the dead weight of the superimposed body; whereas, by passing over the prominence of the heel it derives the full advantage of the convexity, and, by tilting or rotating the foot forwards, transfers the weight of the body to the front of the foot, being assisted still further by the interposition of a synovial bursa between the tendon and the bone, which, by its buoyancy and the displacement of its contained fluid, accommodates the lever to the varying positions of the bone.

The lateral surfaces are good examples of economy of means and space. On the outer surface, where the peronei tendons from their distribution only require to be guided to their destination, we have simply a small spine, serving merely to prevent the tendon slipping forward. On the internal surface, however, more important duties devolve. From the roundness of the heel process, the overhanging of the astragalus, and the weight of the body being directed towards its inner side, the foot would inevitably roll over in this direction if there was not an especial arrangement to prevent it. And, indeed, in cases of weakness, or where the arch is deficient, as in valgus, this frequently occurs.

The tibialis posticus, upon whose tendon this compensating duty principally devolves, passes directly forwards from behind the inner malleolus to its insertion on the scaphoid and internal cuneiform bones. It therefore requires a very strong pulley around which to play, and this is supplied by the under surface of the sustentaculum tali, which, by its double office of supporting the astragalus above and supplying a pulley below, enables the tendon to exert its influence directly upon the body of the astragalus, to counteract the superincumbent force, and preserve the foot in its natural position, whilst the concavity of the surface behind and below the sustentaculum tali affords a safe shelter for the remaining tendons, the arteries and nerves, in their passage to the sole of the foot.

If we now turn to the structure of the os calcis, we find it designed and arranged exactly to meet the exigencies of the bone. Those portions of the bone which have to bear the greatest strain, as well as those that are the weakest, calculating from before backwards, are—

1. The articular surface for the os cuboides, especially at its upper half.

2. The deep groove on its upper surface for the lodgment of the interosseous ligament.

3. The posterior calcaneo-astragaloid articulating surface.

4. The concave surface behind the latter.

5. That portion of the posterior extremity of the bone at which the bursa separates the tendo Achillis from the bone, and which has to sustain the whole force of the action of that tendon.

6. The remainder of the posterior extremity of the os calcis between the latter spot and the tubercles.

1. The articulating surface for the os cuboides is supported upon a very compact and dense body of osseous striæ, which in the middle preserve this compact arrangement for about a quarter of an inch towards the interior of the bone, where the striæ separate to assist in forming the septa of the spongy or cancellated structure of the bone. Superiorly and inferiorly the compact structure expands, joining a similar structure from the upper and lower portions of the great calcaneal process, thus rendering the upper and lower angles extremely firm, as at these points it extends nearly, if not quite, half an inch into the interior of the bone.

2. The weakest portion of the os calcis is undoubtedly that in which the groove is sunk for the interosseous calcaneo-astragaloid ligament. It is here that the bone is narrowest; it is here also that the cancellated cells are largest and the bone most spongy; and it is at the upper surface, or in the groove itself, that in walking, &c., the opposing forces of the superimposed weight of the body behind, and the resistance offered by the front of the foot through the cuboid bone, are concentrated. To enable it to sustain these twofold forces, we find the cortical structure in this neighbourhood extremely hard, and much thicker where it corresponds to the groove. Its density resembles ivory,

rather than the tough material of the rest of the bone; indeed, Professor Humphry describes this as the hardest portion of the os calcis. From this hard dense structure a process of similar character passes from immediately beneath this groove obliquely to the middle of the articulating surface for the cuboid; acting as a tie-beam, in fact, to the interosseous groove, and enabling it to resist the force and strain exerted upon it.

3. If we saw through the inner calcaneo-astragaloid surface transversely outwards through the external or greater surface, we at once perceive the great strength of the bone in these situations. In the preparation before you, you will observe that it is intermediate in density between the structure supporting the cuboidal surface and that composing the interosseous groove. After extending downwards and backwards in this compact form for nearly three-quarters of an inch, its component lamellæ radiate to fill up the interior of the heel-process of the bone, excepting that portion thereof to be described hereafter.

The radiating fibres, however, are not straight, but are arranged with reference to a point of considerable interest. Whilst that portion of the bone which lies in front of the posterior calcaneo-astragaloid articulating surface is weakest in point of volume and structure, the concave portion immediately behind that surface and between it and the anterior attachment of the tendo Achillis, has to bear the greatest strain—a strain, it has been well observed, greater than that borne by any other one part of the body. It has at one and the same time to support and contend against a double force applied in opposite directions: the weight of the body bearing down upon the astragaloid surfaces, on the one hand; the powerful leverage of the tendo Achillis, on the other.

Bearing this in mind, this concave portion of the upper surface of the bone appears to labour under such great disadvantages that we are forced to seek some compensating arrangement by which the bone is here preserved from injury, and, indeed, prevented from being crushed when these two opposing forces are in action. This is supplied by the disposition of the radiating lamellæ or pillars of bone. These, as I have said before, do not radiate in straight, but in curved, lines, their convexity being directed upwards towards the concave surface of the bone; and, whilst they commence in the dense structure supporting the astragaloid surface, they curve backwards and downwards to a still more dense structure which lines the cortex of the heel at its lower three-fourths, the striæ of which run in a different direction, and emanate from a point to be presently considered.

These, however, are not the only means of giving the part support and strength; for, if we carefully examine the cornua of the concave surface, we may observe oblique lines passing downwards and forwards, and downwards and backwards, according to the cornu whence they proceed. These take their support upon a very strong arch formed by, and proceeding from, the dense hard structure supporting the posterior astragaloid articulation, and extending from rather above the centre of this latter to the cortex of the upper portion of the heel-process in such a manner that the centre of the arch corresponds to, and supports the centre of, the concavity.

Proceeding backwards and downwards, we find the cortex of the bone, a dense structure, made up of curved lamellæ, running at right angles to those already mentioned, and receiving the lower and posterior extremities of the latter.

That portion of the cortex investing the heel-process (the epiphysis of Mr. Hilton) is twice the breadth of that immediately above it, and which corresponds to the bursa. It is much more compact, and its lamellæ appear to terminate superiorly in a structure analogous to that investing the inter-osseous groove, and which also receives the lower extremities of the lamellæ constituting the bursal cortex, affording a common bond of union to the two, and vastly increasing their strength. The lower extremities of the heel-bone lamellæ end in the dense, hard cortex of the under surface of the bone. Those curved radiating lamellæ given off from beneath the dense structure of the astragaloid surface terminate in the concavity offered by the curved lamellæ of the heel-process.

Thus we perceive how completely the structure of the bone is adapted to its functions. By this beautiful but simple arrangement its period of trial is converted into its period of strength, for at that moment of intense compression already adverted to, when the heel has to be raised in walking, in spite, as it were, of the weight of the body, the very force exerted by the tendo Achillis, acting through the curved radiating lamellæ upon the astragaloid surface, not only adds to the support of that surface, but in a great degree assists the latter in diffusing the weight of the body over the rest of the foot. This arrangement is well seen in the annexed Plate.

The ASTRAGALUS, the second bone of the internal division of the foot, may be described as possessing a body, a neck, and a head. The body is planted upon the os calcis obliquely across it, its head projecting inwards beyond the inner surface of the greater process of the os calcis; the two bones here being similar to the hinge and corresponding portions of the blades of a pair of compasses; or if you desire a more familiar illustration, the astragalus sits the os calcis precisely as a lady sits her horse in riding. The neck and a small portion of the head rest upon a small articulating surface upon the upper and inner edge of the greater process of the os calcis, whilst the remainder of the under surface of its head is supported by the calcaneo-scaphoid ligament, erroneously called the round ligament. The under surface of the body of the astragalus is supported entirely by the os calcis, with whose two articulating surfaces on its upper aspect it unites by two corresponding surfaces, separated by the groove for the interosseous ligament. The anterior surface of the head of the bone is received into a corresponding concavity on the posterior aspect of the scaphoid. Posteriorly the under surface is prolonged by a beak-like prolongation from its posterior calcaneal articulating surface to hook on to the prolonged corresponding articulating surface on the os calcis, which I have already described. The upper portion presents a pulley-like articular surface, widest in front; whilst anteriorly it presents on either side an articulation for the internal and external malleolus.

From the obliquity with which the astragalus is seated upon the os calcis, the weight of the body in standing, walking, &c., would be directed, and the head of the bone forced, upon the inner side of the foot, were this not prevented, partly by the expansion upwards and inwards of the calcaneo-scaphoid ligament, and partly by a peculiar arrangement of the neck of the astragalus, which is twisted outwards upon itself so that the centre of the head of the bone corresponds exactly with the centre of the posterior articulating surface of the os scaphoides.

The astragalus is described as the "summit" and "key-bone" of the plantar arch. It is said that its upper convex articulating surface forms the "summit" of the arch; whilst the broadest portion of its upper articular surface lying in the front of the summit, the weight of the superimposed body is by it directed to the three inner toes. I think that a further consideration of this bone, of its position, its articulations with the os calcis, and of the requirements of the foot itself, will show that this designation and description are open to correction.

In mechanics, the key-stone is that which is inserted, wedge-shaped, into the centre of an arch immediately over its crown or highest central spot from the ground, having an equal extent of arch on either side between it and the pier, or what is termed the spring of the arch; and consequently exposed to equal pressure on both sides from the resistance opposed by the piers to any superimposed force or burden. The crown or summit of the arch corresponds to the under surface of this stone; so that if a horizontal line is drawn from the spring of the arch on one side to that on the other, and a second line be drawn from the median point of this latter at right angles upwards, the upper extremity of this vertical line, on reaching the under surface of the key-stone, would at the same time impinge upon the summit or crown of the arch, which in a bridge always looks down upon the object spanned (whether that object be land or water), never upwards to the sky. Again, in an arch of a bridge the whole of the under surface of the key-stone is free, and never rests upon the flange or pillar or pier of the arch; and however lofty the superstructure or "extrados," whether it be two or whether it be thirty feet high, it has nothing to do with the summit or crown of the arch. In fact, it was not the roofs of the houses on old London-bridge which constituted the crown or summit, but the under surface of the key-stone, or that spot on the under surface of the arch furthest removed from the subjacent water. It will readily be seen that the astragalus in no way answers to this description. It is not situated in the centre of the arch, neither has it an equal extent of arch on either side, or (speaking of the foot) in front and behind it. Tested by the mechanical arch, the vertical line impinges considerably in front of it. Its under surface is not free; it rests nearly throughout upon the os calcis, whilst its body assists in forming the pier of the arch. Its upper articulating surface looks upwards instead of downwards; in point of fact, having the same relation to the summit of the arch of the foot as the roofs of the houses to the summit of the arch in old London-bridge. Moreover, unlike the key-stone, it is not a fixed bone; it enjoys a considerable amount of motion, of rotation, especially between its head and the os scaphoides.

The astragalus has doubtless to receive the weight of the body, and to transmit it to the three inner toes; but to restrict its uses to these only, gives but an inadequate idea of its real functions. No one can reflect how the body of the astragalus is imbedded or locked between the anterior and posterior calcaneo-astragaloid articular surfaces, and how the posterior calcaneal surface of the astragalus hooks on to, or clings to the corresponding surface of the os calcis, without feeling the conviction, that whilst the weight is, to a certain extent, to be directed to the inner toes, it is not the whole, but a portion only, which is sent in that direction. On the contrary, in standing, a special arrangement is made for the transmission of a portion, and I believe the greater portion of the weight of the body, to the tubercles of the os calcis, whilst by the articulation of the head of the astragalus upon the greater process of the os calcis, a portion of the body weight is also transmitted through the cuboid to the external metatarsal bones. Indeed, it would appear from the position and arrangement of the astragalus that especial precaution is taken to prevent the freedom of motion of the two anterior piers of the foot being in any degree curtailed or interfered with by undue weight thrown upon the toes or otherwise. And it seems to me that for this reason the leg-bone is made to impinge upon the foot at a point so much posterior to its centre, so that the front of the foot by this means obtains an increase of leverage, and consequently requires a smaller expenditure of power to raise it—a fact which quite accounts for the inequality in number and strength between the muscles destined to raise the heel and those required for the elevation of the toes.

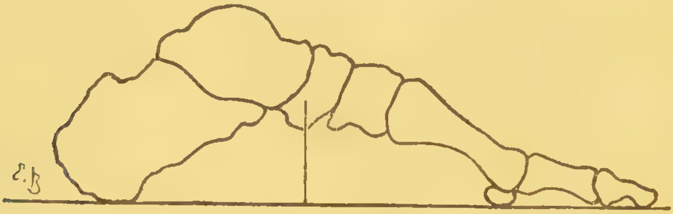
Suppose, for the sake of argument, that the astragalus were indeed the key-bone, receiving the weight of the body as at present, and with the existing arrangement of muscles, &c., what endless embarrassment would ensue! There would be equal length of lever behind the centre of gravity as in front, with a most unequal amount of leverage-power. The amount of the combined power of the gastrocnemius, soleus, and plantaris, of the tibialis posticus, flexor longus pollicis, flexor communis digitorum, and of the peroneus longus, would be beyond all proportion in excess of what would be required; and whilst we should thus witness a solitary and exceptional instance, without example elsewhere, of extravagance and waste of material, the erect position of man would be endangered, if not rendered absolutely impossible, and the capability of raising the toes, when once planted upon the ground, would be completely destroyed.

On the other hand, the existing arrangement of the astragalus with the position of the ankle-joint, and the consequent incidence of gravity, are in exact harmony with the requirements and anatomy of the parts. They serve to equalize the leverage-power, and at the same time account for the apparently great disproportion between the number and strength of the muscles in front of and behind the ankle-joint; since by the centre of gravity falling so far behind the centre or key-bone of the arch (in some positions of the foot, as in the first position in walking, upon the posterior pier of the arch itself), the slightest inclination of the upper part of the body backwards serves to divert the weight and pressure from the front of the foot, thus insuring its freedom of motion, whilst at the same time it decreases the resistance to the apparently inadequate extensor muscles.

The OS SCAPHOIDES, or navicular bone, enters into the inner division of the foot, and is placed intermediately between the astragalus behind and the three cuneiform bones in front, constituting from behind, the third tarsal bone on the inner margin of the foot, and having the cuboid bone to its outer side. It is somewhat oval in shape, having its greatest diameter directed obliquely downwards and inwards. This bone is of great value as supplying a large portion of the socket of the medio-tarsal joint. Its convex anterior surface presents three smooth compartments, the inner of which, directed forwards and inwards, is broader below than above, to be articulated with the internal cuneiform bone. The middle, which looks directly forwards, and is wider above than below, meets the middle cuneiform bone and the outer nearly square, and, inclined forwards and outwards, articulates with the external, each of these surfaces being separated from the other by distinct lines or ridges. Its posterior surface presents the concave and smooth cavity for the reception of the astragalus. Its circumference is rough and convex at its upper, outer, and lower portions, where it gives attachment to various ligaments. Sometimes it has externally a small articulating surface for the cuboid bone; whilst internally and inferiorly its circumference terminates in an uneven but prominent tubercle, into which the tendon of the tibialis posticus is inserted, whilst on its under surface, and external to the latter, is the rough, strong ridge for the attachment of the calcaneo-scaphoid ligament.

The importance of this bone in the animal economy has scarcely been adequately recognised by anatomists. Dr. Cross is very angry with Mr. John Bell for presuming to liken the bone "to the dies with which we play at draughts," rather than to the boot of ancient anatomists; but the tone of his observations suggests the idea of personal animosity rather than of scientific discussion, and even he dismisses this bone as a mere "intermediate agent between the astragalus and the three cuneiform, for the purpose of converting their triple surface into one;" whilst Professor Humphry describes it as being reduced to the subordinate office of "connecting the inner division of the foot with the astragalus, and facilitating the movement of the former upon the latter; and it is the only intermediate bone between the two rows of the tarsus."

From the position which it occupies in the foot, there can be no doubt that this is the true key-bone of the arch. It has an equal amount of arch behind as it has in front, for if we draw a horizontal line between the tubercles of the heel-bone and anterior extremity of the inner metatarsal bone, and cut this through in the centre by a vertical line, this latter will strike the under surface of the scaphoid bone. Like the key-stone of an arch, it has to withstand the compression from both sides, or rather (in the foot) from before and behind. In other words, whilst it is the function of the astragalus to sustain the weight of the body, and to transmit that weight forwards to the three inner toes, &c., as already described, the scaphoid has not only to support this weight, but also the resistance opposed by these toes to the force or weight so transmitted.*



We have here ample cause to admire the very simple, but at the same time beautiful, mechanical arrangement afforded by this bone. For the due freedom of action of the foot, it is necessary that a ball-and-socket joint should exist at the astragalo-scaphoid articulation, combining both strength and elasticity, and at the same time possessing the somewhat opposite attributes of scattering force and of concentrating resistance. The scaphoid bone mainly supports the head of the astragalus, for although the latter rests externally upon the greater process of the os calcis, it derives its principal support from the calcaneo-scaphoid ligament, which, with the scaphoid bone, forms a complete socket. It is here that we find the first part of the arrangement for diffusing or scattering the force or weight through the three cuneiform bones to the three inner toes. From the oblique position of the astragalus upon the os calcis, the weight of the body would of necessity be thrown against the inner side of the foot, and the head of the astragalus would be forced in that direction were it not for some special precaution.

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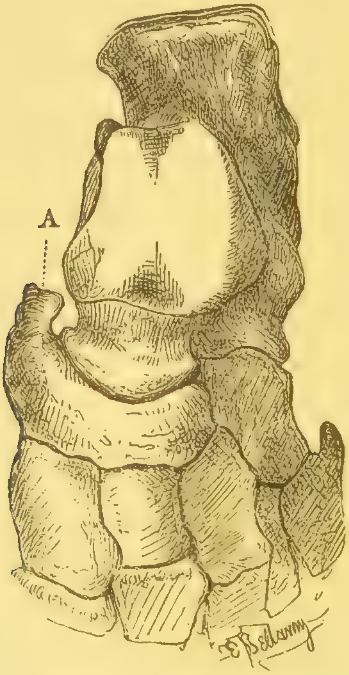
* See Professor Humphry, "Journal of Anatomy and Physiology, 1866," page 188.

The scaphoid bone in its antero-posterior diameter is much thicker internally and inferiorly than it is externally and superiorly, from the posterior margin in the two former situations being prolonged considerably backwards; so that, viewed from behind, the bony socket is at least one-third deeper externally and inferiorly than elsewhere, and the head of the astragalus is made to impinge upon a cavity twisted obliquely from behind forwards and outwards. Not only so, but the inclination of the force through the astragalus towards the inner side of the foot meets with another point of resistance from the arrangement of the calcaneo-scaphoid ligament.

This ligament is usually described as passing from the end of the os calcis to the inferior surface of the scaphoid external to the tubercle. But it also gives off an expansion which extends upwards and inwards to the inner sides of the os calcis and scaphoid; forming, in fact, the inner wall of the socket for the reception of the head of the astragalus. In walking or standing the head of the astragalus bearing upon the calcaneo-scaphoid ligament depresses it downwards, and consequently at the same time renders this expansion tense, causing it in turn to react upon itself (the head of the astragalus), pressing it outwards, and so, in conjunction with the tendons of the tibialis anticus and posticus and the obliquity of the scaphoid articulation, diffusing the weight among the three cuneiform bones, and ultimately among the three inner toes.

The opinion here expressed is supported by what we observe in skeletons of persons of unusual size, when the weight of the body, and consequent strain upon the inner side of the astragalo-scaphoid joint, must of necessity be unusually great. In the skeleton foot of O'Byrne, for instance, the posterior surface of the scaphoid forms a regular bony cup for the head of the astragalus, the inner side of the former being prolonged considerably backwards;



(A) Bony prolongation of scaphoid backwards, forming socket for head of astragalus. (Freeman.)

and this peculiarity is still more marked in the skeleton of the American giant, Freeman. In the latter the inner side is so far prolonged backwards as to reach the neck of the astragalus.

Having thus studied the method by which the weight or force is diffused or scattered through the three inner toes, let us now inquire how the resistance is collected or concentrated, and made to react upon and oppose this weight or force.

The anterior surface of the scaphoid, said to be convex, presents, in fact, three planes or surfaces; the one looking forwards and inwards, connected by the internal cuneiform with the metatarsal bone of the great toe; another directed forwards and outwards, connected through the external cuneiform with the third metatarsal bone; whilst the intermediate, looking directly forwards, corresponds through the middle cuneiform with the metatarsal bone of the second toe. If lines be drawn from before backwards from the bases of the three metatarsal, over the three cuneiform bones, they will be found to converge at a small tubercle on the upper and posterior margin of the scaphoid bone, corresponding exactly to the centre of the head of the astragalus; and if sections of the scaphoid bone be made in the same direction, the lamellæ of the cancellated structure are observed to correspond with this arrangement, by which the resistance offered by the earth to the anterior extremities of the three internal metatarsal bones is conveyed through them and the cuneiform to the scaphoid, and by it again to the head of the astragalus. Hence, we must admit that the scaphoid is by no means the insignificant bone it is usually represented; but, on the contrary, that it is all-important for the due performance of the functions of the foot; that it should always be preserved where practicable (if for no other reason), for the purpose of preserving the attachment of the tendon of the tibialis anticus and the insertion of the calcaneo-scaphoid ligament, and consequently of maintaining the great medio-tarsal articulation and the posterior segment of the longitudinal arch intact.

The CUBOID bone is situated on the outside of the foot, having the fourth and fifth metatarsal bones in front, and the os calcis behind. It is somewhat cuboidal in shape, but its internal antero posterior diameter is more than one-third in excess of the external.

Anterior Surface.—Anteriorly it presents two articulating surfaces, an internal quadrilateral for the fourth, and an external triangular for the fifth metatarsal bones, the former looking directly forwards, the latter forwards and outwards.

Its *Posterior Surface* articulates with the os calcis.

Superior Surface.—The upper surface is convex from side to side, and if carefully examined is found to exhibit three ridges, arranged as a capital Y, the arms terminating respectively at the middle of the articulating surfaces for the metatarsal bones, whilst the tail of the latter passes backwards to the centre of the articulating surfaces on the os calcis, where it meets with a similar eminence. The fibres or pillars of the internal cancellated structure of the bone correspond, so that we here recognise the same arrangement for diffusing the force and concentrating resistance in the outer segment of the foot as on the inner.

Inferior Surface.—The inferior surface is traversed obliquely by a strong projecting ridge, having in front a deep oblique groove, which lodges the tendon of the peroneus longus.

External Border.—The external border is short and rounded, and is marked by the commencement of the groove for the peroneus longus.

Internal Surface.—The internal surface articulates about its middle by a smooth flat portion with the external cuneiform, and frequently more posteriorly with the scaphoid bone.

THE METATARSAL BONES, five in number, and placed between the tarsal bones behind, and the phalanges or toe-bones, in front, have rightly been described as long bones in miniature, each possessing a body and two extremities. The body is arched in its antero-posterior direction, the concavity being directed towards the sole of the foot, and presents three surfaces and three borders or spines, so that when cut transversely across a triangular surface is seen, the base being towards the dorsum of the foot. The metatarsal bones vary in length and thickness:

the first, much thicker, is shorter than the rest; the fifth is longer than the first, but not nearly so thick; the third and fourth are about equal in thickness and length, not so bulky as the fifth, but longer; the second is the longest of the whole.

Posterior Extremities.—The posterior extremity or base of each metatarsal bone is much larger in all directions than the rest of the bone, although it presents the same triangular shape, the broad base being directed towards the dorsum of the foot.

Reckoned from the inner side of the foot, the first metatarsal bone articulates by its base with the internal cuneiform bone alone; the second with the three cuneiform and the third metatarsal bones; the third with the external cuneiform and the second and fourth metatarsal bones; the fourth with the external cuneiform, the cuboid, and the third and fifth metatarsal bones; whilst the fifth articulates with the cuboid and fourth metatarsal bones by a very broad base, which projects strongly on the outer side of the foot, where it may be readily felt through the skin making the external extremity of the tarso-metatarsal joint. The transverse arch of the foot depends upon the aggregation of the triangular bases of these five metatarsal bones, and it would seem that the projection on the base of the fifth metatarsal bone was especially designed to afford a pier to the arch, a point of resistance whereby the arch is maintained when subjected to the weight of the body in standing or walking.

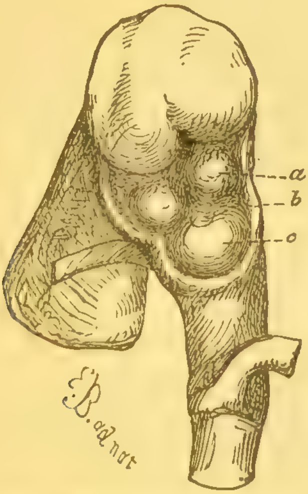
Anterior Extremities or Heads.—The rounded anterior extremity of each bone, flattened on either side, articulates with the phalanges, and projects strongly on the plantar aspect of the foot. The under surfaces of the head of the first metatarsal bone are marked on either side by an articulating surface for the two sesamoid bones. When viewed collectively, the length of the metatarsal bones appears to diminish gradually from the second to the fifth ; this arises in a great measure from the external cuneiform with which the third articulates projecting forwards much more than either the cuboid or middle cuneiform bones, for, as we have seen, the third and fourth individually are of about equal size.

This arrangement is doubtless for the purpose of facilitating the transference of the weight in walking from the outer side of the foot to the first metatarsal bone, and we also find a very simple, though ingenious contrivance by which these bones are enabled to oppose their greatest strength to the superimposed force and weight. The fragile appearance and apparent slightness of the four outer metatarsal bones in comparison with the functions they have to perform, and the great weight which at times they are called upon to sustain, would at first sight almost lead to the presumption that they were inadequate to their allotted task ; but it must be remembered that the weight so superimposed is almost always in transition, and very rarely, if ever, rests on any one individual bone, and, that they should obtain the greatest advantage, we find them so arranged that their greatest diameter is always interposed between the force and the resistance. In this way the foot is qualified for walking—the fifth metatarsal bone is the first brought to the ground, and the fourth, third, and second in rapid succession, until the whole burthen is transferred to and borne by the first. The strong spine or inferior angle on the concave aspect of the first bone looks almost directly outward, that of the fourth obliquely downwards and outward; those of the third and second with diminishing obliquity; whilst the strong spine of the first is so arranged as to offer the greatest resistance to any force which may be exerted upon it. Moreover, when we examine the interior of these bones we find the same design carried out in deposition of the cancellated structure, and the relative thickness and strength of the various portions of their shafts.

The phalanges having already been alluded to, require no especial description here.

Sesamoid Bones.—Mr. John Bell propounded the dogma which was fiercely contested by Mr. Cross "that the sesamoid bones are accidental formations due to pressure." Mr. Berry, late house-surgeon to the Charing Cross Hospital, found them present in the foot of a stillborn baby which he dissected for me; thus proving their existence at so early a period of life that we may rest assured they form a part of the original design and development, and are not due to extraneous causes.

If we lay the metatarso-phalangeal joint open from above we find these sesamoid bones united by a strong intervening elastic ligament, upon which the anterior extremity of the metatarsal bone rests, and which, with the posterior extremity of the phalanx completes the socket of the joint; and here we may also observe the uses of the sesamoid bones and the beauty of their arrangement. The first metatarsal bone, although considerably stronger, is shorter than the second, and were it not for the sesamoid bones would drop below the level of the second metatarsal, which, too slight for the task, would then have to sustain the weight of the body and the various shocks. Situated, however, beneath



THE METATARSO-PHALANGEAL JOINT OF GREAT TOE LAID OPEN.

(*a*, *b*) Articular surfaces of sesamoid bones.
(*c*) Articular surface of first phalanx.
The articular surface of the metatarsal bone is seen above the sesamoid bones.

its head, the sesamoid bones sustain the first metatarsal in its proper place, and enable it to perform its allotted duties. And with regard to the beauty of the arrangement it must be borne in mind that this joint, unlike the medio-tarsal, has to sustain shocks at various angles according to the irregularities of the ground upon which it alights; so that whilst in the latter (medio-tarsal) the ligament or spring is inserted into fixed points, in the former (metatarso-phalangeal) it is attached to two moveable bones (the sesamoid), which, in their turn, are connected with muscles especially appointed to regulate and accommodate their movements to the varying requirements and positions of the joint.

LECTURE II.

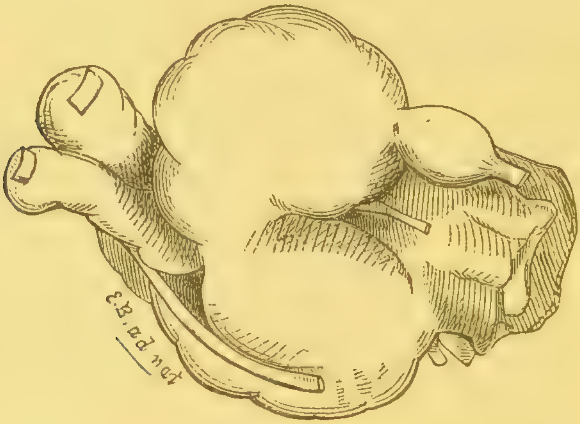
MR. PRESIDENT AND GENTLEMEN,—

THE period allowed for these lectures is too short to admit of my devoting more time to the anatomy of the foot. I must therefore at once proceed to consider the operative surgery of the part, and briefly to enumerate the diseases, &c., for which it has been called into requisition. They have for the most part been—

- Burns,
- Compound fractures,
- Simple and compound dislocations,
- Distortions,
- Caries and scrofulous disease of bones,
- Enchondroma,
- Fibrous tumours,
- Epithelioma,
- Exostosis,
- Frost-bite,
- Gangrene,
- Gunshot wounds,
- Medullary sarcoma,
- Malformation,
- Melanosis,
- Necrosis,
- Perforating ulcer,
- Synovitis,
- Ulceration of cartilage.

In the specimen before you, you have a very interesting case of enchondroma, which Mr. Samuel

Hey, of Leeds, with that kindness and desire of furthering the progress of surgery for which he is so distinguished, has kindly placed at my disposal. The tumour involved the second and third metatarsal bones, overlapping the first, and bulging both on to the dorsum and into the sole of the foot.



My friend and late pupil, Dr. Fayrer, one of the heroes of Lucknow, and at present senior surgeon of the hospital at Calcutta, has kindly furnished me with two examples of epithelial growth.

The first was on the heel of a young Hindoo lad. Dr. Fayrer, on Feb. 2nd, 1862, employing chloroform, cut deeply into the heel-tissue, and removed the growth, which was an inch and a half in diameter, and of a prominent papillary form. One artery had to be tied. The growth had been attended with much burning pain, and the glands in the groin were swollen and painful. The microscopical appearance of the fluid squeezed from between the hardened papillæ presented large oval and elongated cells, with nuclei. The lad left the hospital eleven days after the operation, and the wound was then rapidly cicatrizing.

The second was a case of similar character, situate near the great toe of a sweeper boy, aged sixteen, the glands below Poupart's ligament being painful and swollen. Dr. Fayrer removed the growth on Feb. 26th, and the boy was discharged cured on April 11th. The microscopical appearance was similar to that of the other case.

The late Mr. Delagarde, of Exeter, also kindly supplied me with the particulars of an analogous case, upon which he had operated with success.

In the year 1853 I amputated the leg at its lower third of a man suffering from medullary sarcoma of the os calcis. Before the wound healed the disease reappeared in the stump, and the patient died seven weeks after the operation.

Dr. Fayrer relates a case in which he recently removed a fibro-nucleated tumour from the dorsum of the foot of an English officer, aged thirty-nine. The tumour was almost as large as a compressed orange; the patient did well. He mentions likewise a case in which he removed a melanotic growth, three inches long, from the sole of the foot of a Hindoo fakir, aged fifty. The patient did well. He again came under Dr. Fayrer's care twelve months afterwards for fractured thigh. The cicatrix in the part was firm; no appearance of recurrence of the disease. The glands of the groin, which had been enlarged and tender, had subsided.

Since the completion of my lectures at the College of Surgeons, I have received the following interesting communication from Dr. Thompson, of Droxford:—

"Droxford, Hants, Sept. 9, 1867.

"Sir,—Your lectures in the last *Lancets* have recalled to me a case of Chopart's amputation, of which you might wish to have the particulars. For many years my father suffered much from what was at first a large corn on the sole of the right foot. He injured the part on a ladder, and an open sore of a very painful nature resulted, attended with repeated hæmorrhage.

"At length, in December, 1860, the late Dr. Hutton performed Chopart's amputation in my presence. No untoward result of any kind intervened during the treatment, and my father walked well two months after the operation. He was a man of eighteen stone weight, and very active. No pointing or contraction ever took place, and for six years he often walked four miles a day, and followed his business of a merchant; but, in the early part of the year 1867, a painful tumour appeared in the groin of the same side, resulting in a large cancerous wound, which terminated his life in six months, the cicatrix of the stump remaining sound to the last. The result curiously verified a prognosis given by Dr. Aitken, of the Army Medical

School, who kindly examined the foot with me, that cancer would be developed sooner or later, as the ulcer on the foot was of a decidedly fibroid nature. My father was sixty years of age when the operation was performed."

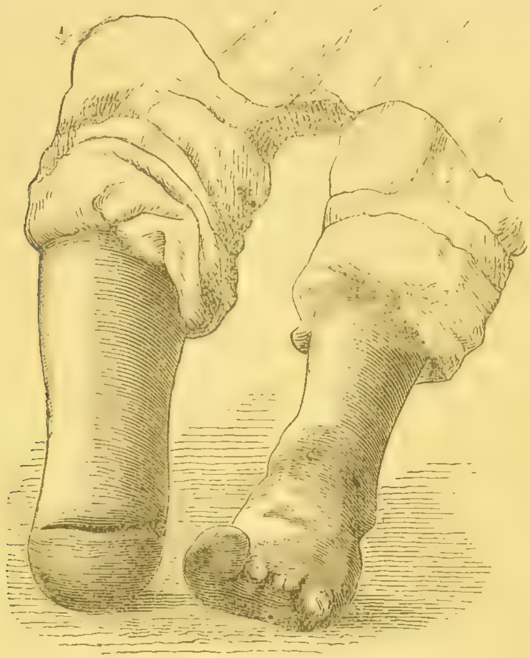
PERFORATING ULCER OF THE FOOT.

In July, 1866, I was consulted by a young man, aged 24, who, twenty years before, was attacked with swelling and inflammation of the great toe of his right foot. As this condition was attributed to frost, no especial attention was paid to it; but, after this state had continued for some time, an opening formed on the under surface of the metatarso-phalangeal joint, which continued to discharge; and a peculiar excrescence formed round the opening, and gradually increased, but gave him so little pain that he was able to go to school and move about his father's farm with little inconvenience, although there was always more or less discharge. For three years the disease was confined to the great toe, after which there formed on the metatarso-phalangeal joint of the little toe of the same foot, an excrescence similar to that on the great toe; but it was removed by caustic, and the part healed up. Soon afterwards, however, a fresh wound appeared in the neighbourhood, and it remained to the time when I saw him. Five years subsequently, the disease attacked the sole of the foot near to the tarsal bones; and abscesses formed on the leg at different times and in various places; but these all yielded to treatment, so that for several years the mischief was confined to the foot. Until two years previously to my seeing him, his walking had not been materially interfered with; but since then it had become much more difficult, from acute pain in the region of the heel and ankle. When admitted into the hospital, the foot was swollen and somewhat distorted, the soft parts presenting a brawny hardness. The great toe was enlarged and misshapen; and there were various ulcerated openings, discharging offensive matter, at the situations already indicated, as well as on the dorsum of the foot.

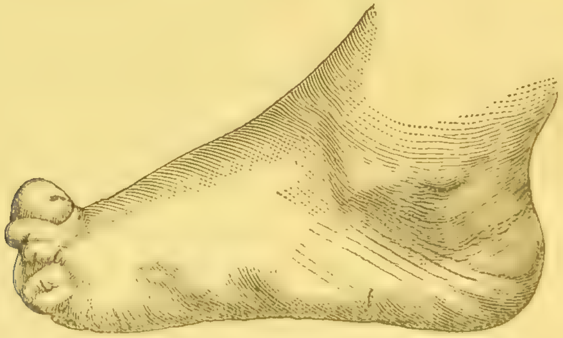
No plan of treatment, either local or general, having hitherto been of service, I removed the foot by a modification of Pirogoff's amputation, and the patient recovered.

Some months after this, Mr. Wilkes, of Salisbury, sent me the particulars of the following interesting case:—

James G., aged 39, a labourer, from West Knoyle, Wiltshire, was admitted into the Salisbury Infirmary on April 20th, 1867, for diseased metatarsal bones of his right foot of twenty years' duration, commencing in a painful corn under the ball of the great toe, preventing him from walking. It afterwards gathered, and discharged for four years, when the first piece of dead bone was removed, and then it nearly healed. Since that time to his admission, pieces of bone had been constantly coming away from the foot, each time preceded by abscess; and, as the dead bone was thrown off, the wound would close; but the foot was never well for more than two or three months at a time. The left foot became affected in a similar manner. About ten years previously, pieces of bone came away at various times; but it was now in a quiescent state. Its great toe, however, was withered; the second and third were mere stumps, without nails; the fourth had been amputated; the fifth was as yet natural; and the metatarsal bones appeared to be sound. From the commencement of the disease (twenty years ago) his feet had always been sweating, whether winter or summer; and, although often cold to the touch, he had never felt cold in them. His feet sweated when no other part of his body did; and, when the wounds were discharging, they were always very offensive. He was a dark and tolerably healthy-looking man, and had never had any other complaint than these bad feet. His mother and two sisters suffered in a similar manner; they were all dead. The mother was about sixty when she died; all her toes were gone, and her feet were diseased and discharging as long as he could remember. His two sisters' feet were more extensively affected than his were; the younger of the two sisters was twenty-two years of age when she died. His father, brother, and two other sisters are living, and at present are healthy. Partial removal of the foot by Mr. Coates having failed in a previous case to arrest the return



of the disease, whilst Syme's amputation was successful, Mr. Wilkes performed that amputation, and the patient did well.



More recently, Mr. Wilkes has kindly sent me the particulars of two other examples of this malady. A gardener, aged 21, a native of Salisbury, was admitted into the Salisbury Infirmary, under the care of Mr. Wilkes, on September 5th, 1868. His feet had been diseased for three years, commencing in hard corns in each foot, under the first joint of the great toe, and under the heads of the metatarsal bones of the middle and little toes. These corns increased in hardness, became tender, suppurated and continued as running sores. When the corns came, the feet began to sweat, but not so the rest of the body. On his right foot are three corns; those under the great and middle toes have been running sores, but that under the little toe has not become so as yet. The left foot presents a cicatrix and withered great toe, from loss of bone after a running sore on its under surface. The middle toe has just been amputated by Mr. Wilkes for caries, and there is a corn on the under surface of the little toe.

The other case is that of H. M., aged 20, first cousin to the preceding patient, and a native of Grinstead, a village six miles from Salisbury, who was admitted under the care of Mr. Wilkes, on August 15th, 1868. His feet had only been bad four months, and consequently were not so much affected. The disease began in a similar manner in hard corns, with offensive sweating, followed by tenderness, suppuration, and sinuses. By rest, the sinuses have closed; but he has still thickening of structures at the heads of the metatarsal bones of the right foot, chiefly in the ball of the great toe; and three corns in each foot, on the under surfaces of the heads of the metatarsal bones of the middle and little toes.

Both the patients are large-formed lads, rather tall, fair, delicate, and strumous-looking. The mother of the first says that her husband had a weeping corn under one of his great toes for four or five years before he died of consumption, at the age of forty. She has buried two children, aged respectively three and six years, from decline; and has one daughter living, with scrofulous glands of the neck. Her own feet have not been affected; but her sister, the mother of the last patient, has had bad feet for years, with discharging corns and diseased bones. She is now a cripple, and unable to move about.

This peculiar and serious affection has scarcely been recognised in this country, but appears to have been first noticed in France by M. Cloquet in the year 1837; subsequently, by M. Boyer and Marjolin; and more recently in a clinical lecture delivered by Nélaton, and published in the *Gazette des Hôpitaux* in January, 1852, under the title "Affection singulière des Os du Pied." Nélaton describes it as commencing with phlyctæna on the pad of the foot. The epidermis is raised by a small quantity of purulent serum. When this is opened into, the subjacent dermis appears of a rose colour; and, when touched, is highly sensitive. This state may continue for some time, when the dermis in its turn gradually ulcerates, and a small fistulous opening is established in the subcutaneous cellular tissue, which will not heal, but continues to discharge serum slightly tinged with pus. If, after some five or six weeks, the sinus is examined by a probe, the subjacent bone is felt rough and necrosed; and a sequestrum subsequently forms. Such are the phenomena which occurred over and over again in the same patient for a period extending over twelve years, and always in the same order. From this patient, Ricord in 1840 removed the sequestrum of the head of the fifth metatarsal bone of the left foot. Two years afterwards, Blandin removed a sequestrum from the first phalanx of the second toe of the left foot. Some time later, Nélaton removed a sequestrum from the first phalanx of the fifth toe of the right foot. Eleven months after this, he performed the same operation on the fourth toe of the right foot. Soon after this, the patient applied to Boyer at the Hôtel Dieu for a greyish-coloured excavation over the head of the first metatarsal bone of the left foot. Boyer removed the whole of the exposed bone, with the surrounding soft parts; and applied the actual cautery to the bottom of the wound. Somewhat later, Michon removed the first toe of the left foot; and, later still, Malgaigne removed the first toe of the right foot. Notwithstanding these numerous operations, the disease was not eradicated; for, in a few months, the patient returned to the Hôtel Dieu with several fistulous openings over the heads of the metatarsal bones of the left foot, for which Malgaigne amputated through the bodies of the bones. Thirty-five days afterwards, the patient left the hospital, to return again in a few months with the same mischief on the face of the stump; and for this the entire foot was removed. Thus, during the twelve years, the patient underwent six operations on the left foot, the last of which was its entire removal; and three on his right. But in 1852, when Nélaton published the case, the patient was still suffering from the same complaint; there were phlyctænæ opposite the heads of the second and third metatarsal bones of the right foot, and the patient regarded these toes as virtually lost.

According to Mr. Minas, in a communication to the Indian Annals of Medical Science, dated Sirsa, 1860, this peculiar affection is called by the natives "Keeveenagrah," signifying a habitation of, eaten or swallowed by, insects or worms.

He describes the disease as commencing in a hard and painful (on pressure) swelling beneath the skin, which gradually enlarges and fistula forms, the most common locality being the sole of the foot.

The exact cause is not known, but the invariable account given is that the foot was accidentally struck against some hard substance, that it inflamed, and was opened by a barber, from which time an ichorous discharge oozed out, and the incised foot presented the black or greyish hue, as if a leaden shot was imbedded within. When this occurs the patient resigns himself to his fate: he ties some boiled leaves round the part, and pursues his avocations as best he may until the pain and swelling become so aggravated as to force him into a hospital.

The publication of Nélaton's lecture was shortly followed by a paper from M. Vesigné, of Abbeville, in the same journal, dated February 5th, 1852. He states that, up to that time, he had searched in vain for an account of this singular affection. His description differs from that of Nélaton, inasmuch as Nélaton asserts that the disease commences in phlyctæna. Vesigné, on the contrary, describes it as originating in a bunion or flat corn with callous thickening; and in this he coincides with Mr. Wilkes, who describes it as commencing in an ulcerating corn in the sole of the foot, gradually invading all the metatarsal bones and phalanges until they are destroyed.

This apparent discrepancy probably arises from these gentlemen having seen the disease at an earlier stage than Nélaton was able to do in his patient, particularly as Vesigné admits the existence of phlyctænæ in his patient. Be this as it may, the following are the particulars of his case.

"It is more," he says, "than twenty years since I was called to a man named Josse, then about twenty years of age, a hard-working gardener, almost insensible to pain, and of robust constitution. He could scarcely walk or bear upon the sole of his right foot, from pain in the metatarso-phalangeal prominence of his great toe, arising from what at first might be taken as a bunion or flat corn, in the centre of which was a brownish spot, a little depressed, and equally dry. Thinking that fluid blood or pus was confined, I carefully scraped off the epidermis until I exposed the dermis and recognised its rose colour. This was followed by an excavation, the edges of which were rounded and smooth, and entirely void of granulation. These edges could be raised all round; and the bottom of the excavation was equally smooth, and resembled dermis more than cellular tissue: whence I judge that the disease originated in the substance of the skin." No benefit resulted from this little operation; and M. Vesigné lost sight of his patient for seventeen years, when he again applied to him. His foot was now attacked with phlegmonous swelling, situated more especially in the soft parts covering the metacarpal bone of the great toe (right). A large pale sanious ulceration, surrounded by thick callous epidermis, replaced the original mischief. With a probe, a piece of loose bone was felt. This was removed; and the patient, considering himself cured, left the hospital.

Two years later, however, or in 1851, he again applied. The inner border of the right foot (that which had been diseased) was extremely deformed.

The right toe and first metatarsal bone were shorter; so that the second toe projected beyond it, and an oval wound existed in the plantar region, over the metatarso-phalangeal joint of the second toe; whilst the disease was appearing at a corresponding point on the little toe, in a flat callosity, with its brown centre.

In the three years' interval since last seen, the left foot had been attacked in the same way and at the same situation, but had progressed with greater rapidity. A large fungoid ulcer, surrounded by callous edges, occupied the sole of the foot; whilst another existed on its dorsum, both discharging fœtid serous fluid; whilst necrosed bone could be distinctly felt.

Now what is the nature of this disease, to which Nélaton gives no name, and Vesigné that of "perforating ulcer of the sole of the foot"? Is it, as Mr. Wilkes considers, one of the many developments of scrofula allied to phthisis? Is it, as Vesigné imagined, a variety of palmar psoriasis? Is it due to syphilitic taint in the system, or to an atheromatous degeneration of the arteries? I fear that our knowledge of this remarkable affection is too limited to answer these questions definitively. All agree as to the locality of origin being the pad of the sole of the foot, corresponding to the heads of the metatarsal bones, especially that of the great toe—due, doubtless, to the pressure exerted on this part by the superimposed weight of the body. At the same time, it is evidently constitutional, as, in the first case which I have here narrated, the patient's hand was similarly affected; whilst Nélaton informs us that his patient, a cabinet-maker, was frequently obliged to leave off his work for a time, in consequence of his hands being threatened with similar mischief. Again, the disease is hereditary. Nélaton's patient was one of six brothers, of whom in 1852, two were still suffering, and one had already died from the complaint. Among the six, the first, third, and fifth were free; whilst the second, fourth, and sixth were victims to this affection. In Mr. Wilkes's first case, as already stated, the mother and two sisters, all of whom were dead, had the same complaint. The mother was about sixty when she died; all her toes were gone; whilst the sisters' feet were extensively affected, pieces of bone continually coming away. The subjects of his second and third cases were cousins; the father of the second suffered from the malady for four years before his death from consumption, whilst the mother of the third is now a cripple, and unable to move about, having for years had bad feet, with running corns and diseased bones.

M. Peau supposed that the disease originated in atheromatous disease of the arteries, and this opinion was supported by M. Desoul in a thesis published in 1864. M. Desoul here reports several examples of perforating ulcer, accompanied by extensive atheromatous degeneration of the arteries of the foot.

On the other hand, M. Masbrenier, resident officer of the asylum at Ville Evrard, examined a patient suffering from "perforating ulcer," especially with reference to disease of the heart and arteries, but he could not discover any abnormal signs either by auscultation or by the use of the sphygmograph.

The heart and arteries were also found healthy in the following case, related in the *Gazette des Hôpitaux*, September 9, 1869, by M. Picot, resident officer of the "Hôpital Necker:"—

J. G., a smith, aged 36, admitted 27th January, 1869, under the care of M. Guyon, for ulceration, situated opposite to the articulation of the foot, with the second phalanx of the great toe of the right foot. The ulcer, about the size of a twenty-centime piece, was characterized by the extreme insensibility of its edges, and penetrated deeply into the joint, which was exposed, very moveable, and grated when the bones were moved. The disease had existed for more than two years, and commenced in a corn; there was also a corn on the corresponding spot of the left foot.

The patient was very pale, but otherwise appeared well formed and healthy, though desponding, which was attributed to his having recently lost his wife. His radial arteries and those of his feet were beating naturally; the sounds of his heart were normal, and his lungs appeared healthy.

The case having been unsuccessfully treated by the actual cautery, M. Guyon proposed to amputate the great toe, but the patient was attacked by jaundice on the 5th February (the day proposed for the operation), and died in a semi-comatose condition on the 10th.

At the post-mortem examination made on the 11th February, thirty-seven hours after death, all the tissues presented a dense yellow colour; the liver was large, but not hypertrophied. An abscess of considerable size, filled with creamy pus, had formed near the convex surface of the right lobe, and two much smaller towards the concave surface, whilst at various points of the same lobe were effusions of bloody fluid, apparently about to become other abscesses. The gall-bladder was empty, the spleen soft, but free from suppuration, as were the kidneys. In the lungs were two small purulent deposits. The heart was healthy and with clots: some red, others fibrinous, and of a deep yellow colour; but the auriculo-ventricular and aortic valves, as well as the aorta itself, were healthy. The arteries of the leg and afflicted foot were found healthy, though subjected to microscopic as well as ocular examination; their coats were supple, and the internal membrane perfectly polished.

The results of treatment have been most unsatisfactory. All sorts of remedies, local as well as constitutional, are stated to have been tried, and to have failed. It is true that Mr. Minas relates the following cases, in which cures are said to have followed comparatively simple measures, but we have not any evidence that these cures were permanent.

Case 1.—Mr. Raddock treated a female patient, in whom the disease was confined to the ball of the great toe; and, finding it limited, cut out the tumour, and cured the patient.

Case 2.—A boy, aged 12, son of a farmer and Jaut by caste, applied to Mr. Minas on 6th April, 1861. The disease had existed only a month, and was confined to the ball of the left great toe; it presented three fistulous openings, through which black granules oozed out, and commenced with a vesicular eruption. His constitution was in every respect healthy.

The treatment consisted in the free application of argenti nitras and bran poultices, and internally pot. hydriod., gr. ss., with decoct. hemidesmi indici, ℥ ss., bis die.

On the 19th day he was discharged cured.

As Mr. Minas justly observes, a case of this disease, " of such a short duration, never before presented itself for treatment, and it now remains to be seen whether it is capable of a permanent cure." Vesigné, who regarded the mischief as a variety of palmar psoriasis, prescribed Fowler's solution of arsenic in doses not exceeding eight drops a day; and continued this treatment for some considerable time, apparently with good results, so much so that, when the patient left the hospital, the wounds were almost entirely closed, although dead bone remained.

But, five days afterwards, he again returned to the hospital with an opaque phlyctæna by the side of the original wound, presenting all the characteristic symptoms of the disease. Notwithstanding, M. Vesigné vaunts this remedy, asserting that, "though a cure cannot be hoped for by simple and constitutional treatment, still the patient may be restored to a state of comparative comfort; whilst the case related by Nélaton would seem to prove that all mutilation is contra-indicated, since operations do not prevent a return of the disease." Nélaton also deprecates operation. "Are we to continue to amputate?" he asks. "He thinks not. We see that, after amputation, the mischief reappears in every part exposed to pressure, the skin of the heel alone excepted; and consequently the whole weight of the body should be made to fall upon the heel exclusively." *

It is exceedingly difficult to understand how a patient with a weeping sore in the sole of the foot (nearly closed though it may be), communicating with dead bone, can be said to have been restored to a state of comparative comfort by constitutional treatment, especially when we read that the patient so restored returned to the hospital after so short

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* "Nélaton a pensé qu'une expérience trop compléte doit faire adopter une conduite opposée après amputation; en effet, on a vu que les mêmes accidents se sont reproduit partout où s'exerce une pression, *excepté à la peau du talon.* En considération de cette circonstance M. Nélaton a cru devoir essayer de faire supporter le poids du corps par le talon exclusivement."—*Gazette des Hôpitaux*, 10th January, 1852.

an interval of cessation of such treatment as five days, with phlyctæna and all the other characteristic symptoms of the disease.

If, therefore, we accept the doctrines of Nélaton and Vesigné, nothing remains but to leave the patient to his fate as a hopeless cripple, and to amuse him with palliative treatment. Both these surgeons appear to me to have overlooked facts of the greatest importance in arriving at their conclusions: first, that the disease invariably commences in the region of the anterior extremities of the metartasal bones and their joints with the toes; that its tendency is to confine itself to this region; and that its progress towards the tarsal bones is marked by extreme tardiness; and, secondly, the complete immunity of the region of the heel. We are left in doubt by Nélaton whether constitutional treatment was employed antecedent to, or combined with, the various operative procedures. Consequently, in the first instance, it would undoubtedly be our duty to remove the sequestrum and diseased soft parts, and to give the patient the benefit of constitutional remedies combined. But if, notwithstanding, the disease returns, there can no longer be a question, considering the complete success that attended Pirogoff's amputation in my case, and Syme's amputation performed for this malady in the Salisbury Infirmary by Mr. Wilkes and Mr. Coates, as well as the immunity of the heel-region already alluded to, that although, as a general rule, we should sacrifice as little of the foot as possible, this is an exceptional disease; and that, when once perforating ulcer of the sole of the foot is established and recognised, it is better at once to remove the whole of the metatarsal bones, either by Chopart's, Syme's or Pirogoff's amputations, than, by palliative operations and remedies, condemn our patient to a succession of painful disappointments.

Dr. Fitzpatrick, retired Surgeon-Major of the Indian Service, has kindly favoured me with the following letter:—

LENHAM, KENT, 7th July, 1869.

DEAR SIR,—The paper which you read before the Medical Society, in January last, on "Perforating Ulcer of the Foot," attracted my attention in the *British Medical Journal* of the 26th June, and it struck me that the disease was similar to one from which the natives of India suffer, in proof of which I send you a paper by Inspector-General of Hospitals, Dr. Eyre, from the "Indian Annals of Medical Science" for 1860, with an account of seventy cases of what he names "Tubercular Foot;" and though the description differs somewhat from that given in your paper, I have no doubt the disease is the same.

In your paper there is no reference to swelling of the foot, a peculiarity attending the disease in India, and which leads me to think the disease originates in the bones, and first appears outwardly in the shape of a corn, which speedily ulcerates, and though an ulcer may cease to discharge for a time, fresh ones appear; I cannot, therefore, agree with Vesigné, as to the disease "commencing in an ulcerating corn in the sole of the foot gradually invading all the metatarsal bones and phalanges until they are destroyed." I believe the reverse to be the case.

The experience of those conversant with the disease in India is, that the removal of the foot is the only remedy. In the four cases I operated upon, alluded to in Dr. Eyre's paper, there was no return of the disease, nor is there any record of such a result; on the contrary, several cases operated on have been seen several years after in good health. One case is recorded by Dr. Fletcher, having been seen eleven years after, cf "robust and sleek appearance." I adopted no particular operation, but removed every diseased portion. In two cases there was enough of the posterior part of the foot saved to make the limbs tolerably useful.

I am, &c.

H. Hancock, Esq.

TUBERCULAR DISEASE OF THE FOOT.

Considered by some surgeons as identical with "Perforating Ulcer," "Tubercular disease" presents so many points of distinction, that it is worthy of separate consideration.

These points of distinction are in "Perforating Ulcer."

Its commencement in corns under the metatarso-phalangeal joint.

Its being confined to the anterior part of the foot.

The offensive sweating of the foot.

The absence of tubercle.

Moderate swelling.

The disease being hereditary.

Garrison-Surgeon Godfrey appears to have been the first to call attention to "Tubercular Disease of the Foot" in the *Lancet* for June 10, 1846.

The subject was revived in the "Indian Annals of Medicine and Surgery" for 1859, by Mr. Eyre, of the Madras Medical Service, who, at page 513, gives 70, and in a supplement at page 813, the particulars of 44, or in all, of 114 cases of this disease.

According to this authority, the patient presents *one* foot swollen to double, treble, or more, the natural size, the toes far separated, the swelling confined, as by a line of demarcation, to the foot; colour of the skin unchanged, but studded with tubercular-like prominences, some entire, some ulcerated; the ulcers surrounded with hard elevated edges and in the sinuses the probe passing deep into the substance of the foot; the discharge of sanious quality.

In some cases the swelling and tubercles occupy the fore part of the foot, not extending beyond the metatarsal bones.

The previous history elicits that three, five, seven, or more years before, one or more hard lumps appeared on the foot in various parts; the foot began to enlarge, and continued to do so slowly, and without pain or constitutional disturbance. This state continued for a long period, after which the foot enlarged from time to time, the bulk alone proving inconvenient. At last the tubercles ulcerated and became painful. Even then the general health and appearance were but little affected. After a time, however, when the disease and pain had existed for a long period, there was wasting and diarrhœa. No complications of diseased lungs, nor abdominal organs, could be detected, but the natural termination of the disease was in death from diarrhœa.

The morbid appearances differed at different stages of the disease. In some the bones had become totally deprived of earthy matter, in others they were preternaturally hard.

In some the section presented the bones and soft parts converted into a uniform gelatinous mass. In others, again, the muscles were healthy, and the bones alone diseased, in some presenting a peculiar honey-combed appearance. Invariably, numerous minute tubercles, resembling fish roe, were observed intersecting the muscles, and extending from the bones to beneath the skin, and nodules composed of the same, often black in colour, and surrounded by pus, and these nodules were not only found lying among the soft parts, but also within the honey-combed cavities of the bones, particularly of the astragalus and os calcis. Osseous spiculæ are frequently found near the large bones, but, in one instance, immediately under the skin.

In every instance the disease terminated at the ankle-joint.

Mr. Eyre and Dr. Fletcher agree that this is a disease *sui generis*, the striking peculiarity being its strict locality, and, although altering all the tissues of the foot as if by some poisonous matter multiplying itself, it does not extend to, nor affect any other part of the body.

Dr. Bidie, on the contrary, says that he has seen a disease very similar to it on the north-east coast of Scotland affecting the hands, the cases occurring among fishermen and their families; whilst Dr. Fitzpatrick notes that in one of his patients the lower end of the tibia was diseased, the finger could be passed into the bone, and its end squeezed between the fingers.

Mr. Day, Assistant-surgeon at the Civil Hospital, Bellary, macerated two feet, which had been amputated for this disease.

In the first, the os calcis was hollowed into small irregular cavities, one of which passed entirely through the substance of the bone; these places had white nodules in their interior the same as perceived in the softer tissues; the posterior surface of the os calcis also presented numerous spiculæ of bone. The astragalus had the same honey-combed appearance, and with the os calcis was harder, whilst the rest of the tarsal bones were softer than natural.

In the second case, the os calcis, astragalus, and scaphoid were anchylosed together and hard, whilst the three cuneiform and cuboid were soft. The posterior part of the os calcis was hollowed into one large cavity, having a circular orifice at the internal side, and a small canal leading to its plantar aspect. The cavities were filled by a darkish-looking concretion, and numerous bony spiculæ. The astragalus was also irregularly honey-combed.

The disease was not amenable to constitutional treatment, the only remedy capable of saving life being Chopart's operation, where the astragalus and os calcis remained sound, or amputation of the leg, the latter operation being that most commonly adopted.

Of 114 cases of tubercular foot,
96 amputations were successful,
12 died after operation,
4 died without operation,
2 refused operation and sank from diarrhœa.

The opinion of Dr. Godfrey, that this is a purely local affection, and its removal a complete cure, is confirmed by the history of 22 individuals traced after operation. Of these, 8 between 6 and 12 years, and 14 between 2 and 5 years, had the remaining foot sound and the health good. He adds:—

"The conclusions respecting this singular disease may be summed up as follows:—

"(*a*) It is confined to the one foot, either right or left, in about equal proportions.

"(*b*) The subject of it belongs to all classes and occupations.

"(*c*) The age of the subjects of the disease ranges between 20 and 60, the period between 20 and 30 affording the greatest number of examples; that between 50 and 60 the smallest; whilst, as to sex, the proportion was 4 females to 114 males."

In the year 1854, Dr. Ballingale furnished a paper to the Transactions of the Medical and Physical Society of Bombay, giving an account of the malady, wherein he states:—

"At first sight it somewhat resembles elephantiasis, the foot being uniformly and generally enlarged to about three or four times its natural size, but in no instance has the affection extended beyond the ankle, the leg remaining natural in appearance, though atrophied from disease. The toes also seem less involved than the other parts of the foot. On the integument are seen a number of elevated tubercles, resembling the granulations seen at the orifices of sinuses, from some of which thin serous pus exudes, with occasionally a pulpy granular substance. Sinuses extend in various directions from the openings to the centre of the foot.

"On making a section of the part, the bony structure is found almost entirely removed, a few osseous spiculæ only remaining here and there, so that the whole may be cut with a knife, the articular cartilages and synovial membranes being destroyed, excepting those of the astragalus and toes. The situation of the bones is occupied by strong areolar textures, with spaces varying from a pin's head to a pea in size, filled with pulpy granular matter.

"The integuments are considerably thickened, the skin and subcutaneous cellular tissue being hypertrophied as in elephantiasis.

"The soft parts of the leg are atrophied, but otherwise normal in structure; the medullary canal of the tibia is much enlarged, the bone being reduced almost to a shell."

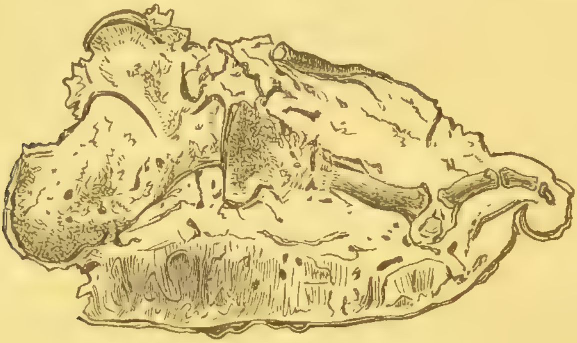
Dr. Aitchison, writing from Jhelum in 1860, relates, among others, the following instructive case:—

A female, aged 30, suffered for two years from this complaint. Situated around her wrists, the disease had spread to deeper than the cellular tissue under the skin, and to the skin itself, which was unchanged in colour, but studded with tubercular-like prominences, some entire, some ulcerated, the ulcers surmounted with hard elevated edges, and united to each other by sinuses, which extended under the skin from one to another, through the cellular tissue. *None of the sinuses led into the deeper tissues.*

Having tried various remedies without success, Dr. Aitchison applied the actual cautery. Under this treatment the sinuses gradually became obliterated, the tuberculated and thickened skin returned to its natural state, the ulcers cicatrised, and the patient left the hospital cured in a month.

The patient was again seen some months afterwards; the cure continued perfect.

The following woodcut is taken from a preparation of tubercular disease of the foot, presented to the Museum of the Royal College of Surgeons of England by Dr. Fayrer, Senior Surgeon to the Hospital at Calcutta.



OPERATIONS IN THE FOOT.

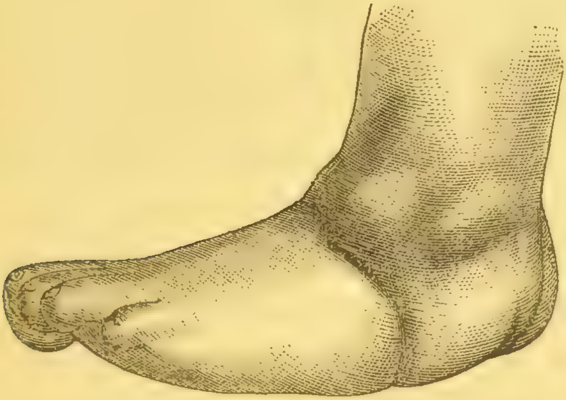
In October, 1787, Mr. Turner, of Yarmouth, at the suggestion of Dr. Aiken of that town, amputated through the metatarsal bones of a woman, aged 23; and in 1799 Mr. Hey announced his operation of disarticulation of the metatarsal bones at the tarso-metatarsal articulations, as a substitute, where practicable, for amputation at the upper third of the leg. In the year 1821, Mr. Liston removed the inner malleolus, the astragalus, scaphoid, and two cuneiform bones; but the result of the operation not having transpired, it did not take any hold on the attention of the profession. With these exceptions, previous to the year 1828, when Mr. James, of Exeter, introduced Chopart's operation into England (Mr. Syme performing the second operation, and for the first time in Scotland, in 1829), affections of the foot, whether from disease or accident, were abandoned literally and indiscriminately to amputation of the upper third of the leg (a longer stump being a luxury reserved for the rich). In vain did Tyre of Gloucester, Hey of Leeds, and the late Sir A. Cooper, protest against this reckless proceeding; the practice still prevailed until the year 1845, when Mr. Syme made known to the profession his celebrated method, which, called by his name, at one and the same time indicates amputation at the ankle-joint, with a stump formed from the dense structure of the heel.

This operation struck a great and decided blow at amputation of the leg; but brilliant and scientific as it was, it influenced the actual surgery of the foot but little. It made a better stump, it is true; it preserved a greater length of leg; but it equally sacrificed the foot. At this time British surgery boasted of but four standard operations connected with the foot—viz., excision of the astragalus, and Hey's, Chopart's, and Syme's amputations. And so matters continued until the year 1847, when Mr. Thos. Wakley performed his celebrated operation for resection of the lower ends of the tibia and fibula, with excision of the astragalus and os calcis. This was followed soon after by the equally celebrated operation of Mr. Teale, of Leeds, wherein he excised the os calcis, astragalus, and cuboid bones, and thus instituted a new era in the British surgery of the foot. To my mind, these two operations rank among the highest and most brilliant achievements of modern surgery.

Previous to this, as we have seen, operative surgery of the foot consisted in amputating between the disease or accident and the body. To remove a diseased bone from amongst healthy bones, to remove a bone from the posterior part of the foot without at the same time sacrificing the anterior portion of that organ, had been deemed (Liston's case excepted) an impossibility. Surgeons regarded the foot as a whole without reference to the value of each integral part; they permitted their minds to run in one particular groove only; they were carried away by undue, and I may say, groundless dread, handed down by writers from generation to generation, of the danger of cutting into and exposing the internal structure of the tarsal bones, thereby, as they believed, producing inflammation, pyæmia, and a host of imaginary evils, whilst, with singular inconsistency, they did not hesitate with gouge and blunt chisel to bruise and crush that very structure, a clean cut of which with a sharp saw in their eyes led to death and destruction. Because strumous disease will frequently originate in the cancellated structure of these bones, they inferred that inflammation and caries, must, of necessity, always originate therein: they do not seem to have imagined it was possible that they could equally originate and exist for a great length of time in the articulations without involving the interior of the bones at all. They were impressed with the notion that disease or accident affecting one part of a synovial membrane must inevitably involve not only every other portion of that synovial membrane, however remote, but must also invade the internal structures of the several bones invested by it. They did not attempt to test the correctness of these theories, they were satisfied to take them for granted, and sacrificed accordingly.

But Wakley's and Teale's operations proved that not only could these supposed impossibilities be overcome, but that even disease, unpreceded by injury and situated in the posterior region of the foot, might not only be removed, but removed with advantage to the patient; and that disease of this region did not of necessity involve the destruction of the entire foot. The result was what might have been expected: surgeons began to shake off the trammels of custom, and to think for themselves. They began to consider the beautiful mechanism of the foot, or any portion thereof, however small, as something worth preserving; so that we now enumerate as standard operations, in addition to those already named, "excision of the ankle-joint," "excision of the os calcis," "excision of the cuboid bone," "subastragaloid and Pirogoff's amputations," besides other operations performed in almost every region of the foot.

On the 1st of May, 1855, Mr. Teale surpassed his previous success in removing from the foot of a young woman, aged twenty-two, the calcaneum, astragalus, navicular and cuboid bones. The patient returned in six months to her duties as a domestic servant, and is now engaged in making clothes by the sewing-machine. When she has much walking she assists herself by the use of a stick. Mr. Teale has with the greatest kindness authorized me to present the cast of the case I now exhibit, in his name, to the museum of this College. In allusion to this and other operations he observes: "The general result has been very satisfactory. Indeed, I have adopted the operation as freely for disease limited to the posterior part of the foot as I have done Chopart's for disease limited to the anterior part. There is, however, one condition necessary to success—namely, that we select such cases as are the result of pure healthy (if I may so say) inflammation of ligaments, and not those which have originated in the cancellous structure of the bones, and which Sir B. Brodie rightly attributed, as I think (despite of what is now-a-days talked about strumous synovitis), to struma."



A French author, in a treatise of comparatively recent date, asserts that no one has ever proposed, as a standard operation, to amputate through the continuity of the anterior row of tarsal bones. "These operations, recommended by necessity, should never become the rule. Those surgeons who regard the foot as a solid whole, and who perform these operations, have the advantage of making a regular-shaped wound, but they expose the patient to the double danger of section of the bones and of the joints. Matthias Mayor," he continues, "in one of the eccentricities for which he was notorious, would reduce this study to its most simple form. According to him, the foot is but an undivided whole, the same as the leg or thigh. The only questions which govern him are the extent or limits of the disease. He cuts through the soft parts and exposes the bone behind these limits, and applies the saw on their continuity as far as possible from the tibio-tarsal joint, without considering the small bones or the difficult joints which the instrument may divide. We will not," he continues, "pause to refute this doctrine of the surgeon of Lausanne, which, if he will pardon the expression, would rather cut the Gordian knot than try to untie it." I cannot help thinking that the eccentricities of M. Mayor, at all events in this instance, take a very sensible form, and that he is a better surgeon than his critic. He evidently acted from practical experience, the latter has written from theoretical imagination only. Malgaigne, on the contrary (at page 277 of the seventh edition of his Manual), says, if by sawing the bones of the tarsus across, instead of disarticulating them, we can thus preserve a portion of the second row of tarsal bones, the result would certainly warrant our taking the method into serious consideration.

Having given this subject more than average attention for many years past, I entirely endorse M. Mayor's views. I would reduce this study to its most simple form. I would desire to be governed by the tangible reality of the extent or limits of the disease rather than by the doubts and uncertainties of abstract theories, and I consequently advocate strongly as a standard operation "to amputate through the continuity of the first or second row of tarsal bones in preference to sacrificing joints when there is no necessity for such sacrifice." I do this, not because I regard the foot as a mere undivided whole like the thigh or leg, but because I regard it as an aggregation of several parts, each perfect in itself, placed there for a given purpose; each and all of far too great value to be destroyed without a cause, and, above all, because the experience of many years has proved to me both the safety and value of this proceeding.

The joints are of especial value in completing the mechanism of the parts connected with them. The medio-tarsal joint, for instance, completes the posterior segment of the longitudinal arch. Destroy this joint, and the os calcis and astragalus are at once deprived of their anterior support, with the consequent elasticity and motion. Can anything be more unphilosophical than to advocate the sacrifice of any bone or joint of the foot for no other reason than that a particular operation should be performed? Yet this has been done, and in the following terms: "The scaphoid bone is sometimes left in Chopart's operation in front of the astragalus through inadvertence. We once saw Dupuytren commit this error. Lisfranc even relates a case in which he saw the scaphoid left, and which ended successfully." It is scarcely possible to conceive greater ignorance of the subject or of the value of the parts than these observations evince.

Mr. Morgan, whose declining health has deprived the Bristol Hospital of his valuable services, appears, with the exception of Mr. Gay and Mr. Tudor (of Dorchester), to be the only British surgeon who, as far as I can discover, has systematically followed this plan. He writes me:—"I may perhaps be permitted to state the result of my experience on two points of practical interest. 1st. In amputation of the anterior part of the foot, more forward than Chopart's operation, the patients do very well by ignoring the joints and sawing through the bones at the point of election." Mr. Gay also says:—"I always saw through the row of tarsal bones, keeping as close to the front articular processes as possible; for in a case which I had in the Free Hospital in 1845, the wound was kept open by the extrusion of the cartilages." Whilst Mr. Tudor observes:—"I never found the slightest disadvantage in sawing straight through the bones, whatever part of the foot it may be in, without following the principles laid down in some books of passing the knife between the articulations."

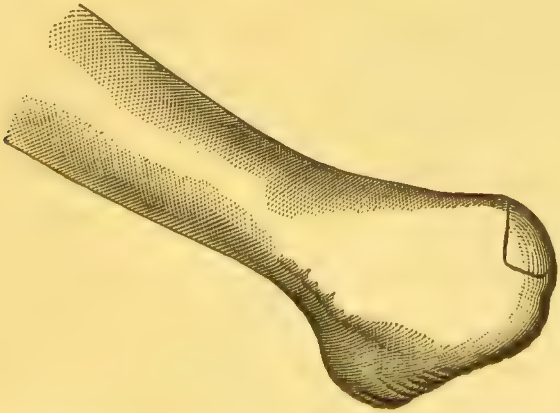
Mr. Huggins, San Fernando, Trinidad, West Indies, writes me 31st July, 1866:—"In 1859, whilst acting for a *confrère* who has charge of the hospital of this small town, I amputated the foot of a coolie immigrant, and sawed through the bones instead of attacking the articulations. Another *confrère* who was assisting me said, 'But are you going to saw through those spongy bones?' as he called them. I replied, 'Certainly.' 'But,' he rejoined, 'it is against all rules, and you will have great suppuration.' My answer was that I did not think so. At any rate, I would try it. The coolie made a good and quick recovery, and could walk well a few months after."

The result of experience convinces me likewise that the danger of pyæmia from cutting through the tarsal bones has been greatly exaggerated; after all, it would seem to be of very rare occurrence in this country, for judging from the returns with which I have been favoured from all parts of England of the several operations performed upon the foot, the occurrence of this malady does not amount to one per cent. upon the number of operations performed. And indeed, when we compare the extent of cut surface exposed in the soft parts with that of the bones, it is difficult to understand why, when it does occur, it should be attributed so entirely to the bone and not to the soft parts; it so frequently follows operations where no bony structure is either exposed or involved, that I must confess my scepticism in the matter. And it is an interesting fact, as supporting this opinion, that Mr. Syme, in enumerating the advantages of his operation, observes, "The tibia and fibula are divided through the *cancellated* structure, and you thus avoid the danger connected with opening the medullary hollow, especially where there is a disposition to phlebitis."

That disease does not always originate in the cancellated structure of these bones, and that, commencing in the articulations, it may there exist for a considerable period without invading that structure, has been abundantly proved; it is frequently so superficial that, as Syme remarks with regard to the cancellated structure of the lower end of the tibia, the removal of a very thin slice will be sufficient to eradicate the mischief; and I would add that mere increased vascularity and softening, without actual change of structure or deposit of tuberculous matter, is not sufficient to justify the condemnation of the entire bone.

This is exemplified in the preparation before you, taken from a girl aged eighteen, who two years before her admission into Charing-cross Hospital suffered severe pain in her left instep, followed by the formation of abscesses, which burst from time to time, healing and bursting again. She entered a metropolitan hospital, and went to a seaside infirmary without deriving any benefit, and she ultimately came under my care in May, 1863. Finding that rest and the ordinary treatment did not improve her condition, I decided upon removing the diseased part. The arch of the foot was now much swollen, and the soft parts thickened. Three open wounds were noticed on the upper, and one on the outer surface of the foot. The limb was cold, and the wounds were glazed and of a dirty yellow colour, with irregular blue margins, and discharging a thin sanious matter. A probe could be passed into the tarso-metatarsal joints. The anterior tarsal bones themselves were felt to be rough and denuded of cartilage, and sinuses extended in various directions.

I removed the front of the foot by the double flap, sawing through the first row of tarsal bones in their continuity. The condition of these bones was doubtful, but I determined to give my patient the benefit of the doubt, and the result justified my decision. The wound healed for the most part by adhesive inflammation, and healthy granulations springing up in the remainder, she was discharged cured in six weeks.



In the year 1845, for a case of injury to the metatarsal bones, Mr. Luke made a dorsal and a plantar flap, and sawed through the three cuneiform bones, removing the entire cuboid bone, which was loose. Erysipelas followed, and the superior flap sloughed; but in three months, the patient, who was twenty-four years old, was able to resume his employment as boiler maker.

Mr. T. J. Walker, of Peterborough, writes me word:—"I have still under my care a case in which, for caries, I performed a modification of Hey, removing, with the metatarsus, the greater portion of the two internal cuneiform bones. The operation having only been performed a month, I cannot assert positively that the case is cured, but the stump is all but entirely healed, without sinuses."

I could multiply these cases were it necessary to do so, but they are quite sufficient to prove that tarsal bones should be cut through in their continuity where possible, in preference to removing the entire bones.

They also serve to neutralise the dread which has been inculcated of opening the large synovial membrane connected with the cuneiform and metatarsal bones, and they are strengthened in this respect by the case of Surgeon O'Doherty, related in the *Dublin Quarterly* for 1859. He removed the second metatarsal bone with its corresponding toe. The operation was difficult, and inflammation and abscess followed, but the patient ultimately did well. And still more are they strengthened by the following case, which Mr. Joseph Walker, of Burslem, has with the greatest kindness and liberality placed at my disposal, and which I believe to be unique:—

A boy, aged fourteen, was admitted into the North Staffordshire Infirmary on March 14th, 1865, under the care of Mr. Walker. He had been leading a horse, which was drawing a heavy railway waggon, and catching his foot in a crossing box, the waggon ran over it. There were two lacerated wounds of the leg, and an extensive one of the heel and sole of the foot; and over the instep, at a point corresponding to the scaphoid bone, was a rounded hard prominence, measuring an inch and a-half antero-posteriorly and an inch transversely, the skin over it being very tense. There appeared to be a sharp edge, with a rounded upper surface; in fact it felt much like the scaphoid bone. An attempt was made to reduce the dislocated bones, and this failing, chloroform was given, and an incision made over the prominent part. The two external cuneiform bones were found lying upon the scaphoid bone, with their metatarsal articular surfaces upwards. They were easily removed by a few touches of the knife, and the wound was closed by wire sutures. Owing to the severely crushed state of the heel and sole of the foot, the wounds were long in completely healing, and free suppuration occurred. In two months the patient was allowed to walk with crutches, the wound of the operation being quite well, a slight depression still existing in the site of the cuneiform bones. In another month he left the infirmary, the ankle being still very stiff, but able to bear considerable weight. When last seen as an out-patient he could use his foot comfortably.

Before quitting this part of my subject I would venture to offer the following suggestions as to operations on the foot:—

(*a*) That we should perform our operation as close to the diseased or damaged structure, and preserve as much of the foot, as possible with safety to our patient.

(*b*) That where practicable, we should cut through the tarsal bones with a saw in preference to disarticulating them.

(*c*) That we should avoid the destruction of joints whenever we can do so.

(*d*) That disease of one articulating surface does not of necessity demand the removal of the entire bone; as, for instance, when confined to the tarso-metatarsal joints, or to the joints between the cuneiform and scaphoid, it is not always necessary to remove the whole of the cuneiform bones on the one hand, or of the entire scaphoid bone on the other. In such cases, however, the diseased portion should be removed by a clean cut made with a saw, and not bruised off by a gouge or chisel.

(*e*) That whilst the openings in the skin cannot be relied upon as indicating the exact situation of the bone mischief, the existence of these openings, even if there be several, or the thickening and discoloration of the skin and soft parts, do not of themselves contraindicate operative procedure, since, as pointed out by Sir W. Fergusson, the soft parts, when relieved of the source of irritation, will speedily return to their natural condition.

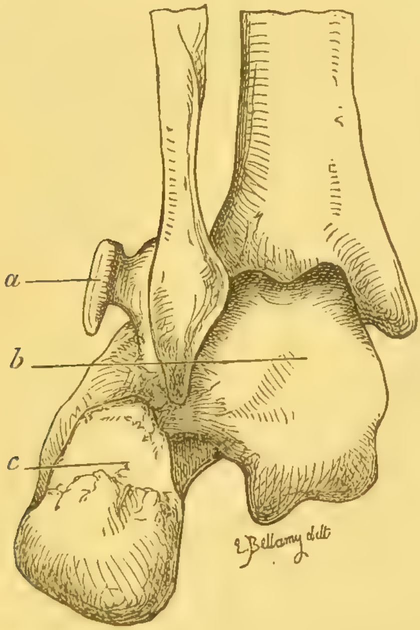
After partial amputation of the foot, the bones, ligaments, and muscles, especially in young patients, appear to accommodate themselves to the altered condition of parts. The bones will, in some instances, become changed even in size and form, whilst the muscles contract new adhesions. These, however, are not the only phenomena which occur, tending to the reparation of parts. I allude to the deposition of new bone, either from the extremities of long bones, or from the periosteum, or from the cut short bones.

Textor expressly asserts the formation of new bone, and this to an extent exactly necessary to produce a new and perfect articulation of the ends of bones upon each other. He states that he found lengthening of the ulna to the extent of a quarter of an inch, on which the radius moved, as in the natural condition, and the trochlea of the humerus appeared as perfect as if none of it had been taken away. Wagner, on the other hand, asserts that examination during life of persons who have recovered after extirpation of short bones, shows that the defect has been remedied, as far as possible, by the approximation of the bones which lie nearest together, the interval which is left appearing to be filled up with a ligamentous material, in which, according to Reid, masses of cartilage or bone are sometimes deposited.

Sir W. Fergusson, in a case which he amputated at the tibio-tarsal joint seven years after he had extirpated the inner half of the os calcis for caries, found the bone partly regenerated, and the place of the lost substance partly occupied by a fibro-cartilaginous material.

I would also remind you of the following highly practical observations made by Mr. Hilton whilst your Professor of Surgery:—"Surgeons should be careful not to disturb unnecessarily the granulations or periosteal membranes which they meet with in operations associated with diseased bone, but, on the other hand, leave all the vascular granulations which surround the diseased bone and line the inner aspect of the periosteum; for experiments, experience, and sound physiology show that if we can secure these bone-producing vascular structures from local injury, we give nature a fair chance of manifesting her powers of speedy reproduction or removal of bone. No doubt in this case (one which he had described) a representative cuboid bone has been reproduced, for there is an equal and continuous ossific resistance along the whole length of the outer side of the tarsal portion of the patient's foot."

We have, however, still much to learn with respect to the deposit of new bone, which we frequently observe takes place without either of the above-mentioned causes. The mere alteration in the relation of parts would seem to be sufficient for its production. Witness the result of an unreduced dislocation of the head of the humerus or of the femur; the displacement of a tendon from its natural groove (as seen in the preparation before you). The tendons of the peronei muscles were displaced from their groove behind the fibula; there was no fracture, no exposure of cancellated structure of that situation, but nevertheless we find a new osseous hook, or hemular process, thrown out for the purpose of compensating these tendons for their lost position.



a Abnormal hemular process thrown out to receive peronei tendons.
b Astragalus displaced.
c Os calcis.

And again, observe what obtains when muscles are violently or accidentally separated from their attachments. I have seen three cases of violent detachment or rupture of the adductor longus muscle from the pubes. They all occurred in the hunting field, the patients having been forced to throw the adductor muscles into sudden and violent action from their horses shying, jumping, or lunging unexpectedly. In neither case did I see the patients for some weeks after the occurrence. They all informed me that they felt something snap at the time; that they experienced great pain, and could no longer grasp the saddle; that they had gradually lost the pain, but were now frightened by finding something form in the upper and inner part of the thigh. Upon examination I found the adductor longus muscle in all the three cases separated from its attachment to the pubes, in one instance to the extent of nearly two inches, whilst the interval between the two was filled by a bony styloid process, or exostosis, originating from the body of the pubes, and giving attachment by its other extremity to the detached muscle.

Whilst we must of necessity regard with satisfaction the increased resources which we now possess, from the introduction of the various operations to which I have adverted, we should not forget that many accidents of the most formidable appearance, and seemingly of the most serious and unpromising character, will frequently do well, and leave the patient a good and useful foot without any operative procedure whatever. Mr. Hilton has designated this practice "bloodless conservative surgery;" and in my opinion its importance and value cannot be estimated too highly. Sir Rutherford Alcock, in a paper upon "Gunshot Wounds of the Foot," read before the Royal Medical and Chirurgical Society, soon after the civil war in Spain, dwelt strongly upon this point—"that danger of wounds of the foot was inverse to the extent of such wounds." This quite coincides with what I have observed in my own practice. The dread of tetanus, it seems to me, has undue influence over the treatment of such cases. A wound so free and extensive as to neutralise, or prevent altogether, the irritation and suffering caused by congestion and tumefaction of the soft parts and the consequent tension, and which at the same time affords a free and uninterrupted outlet for the discharge, never mind how dangerous in appearance or how complicated its situation, may frequently be left to Nature, and will as frequently do well: whilst an injury apparently of a trivial character will often lead to the loss of the limb, or even of the life of the patient. I have unhappily seen some few cases of tetanus in the course of my career, and they have, for the most part, followed injuries of the latter class.

A child, aged four years, came under my care at the Charing-cross Hospital, whose left ankle had been run over by a waggon, and the joint was so completely laid open on either side that the water, in washing it, poured freely through the joint. Determined to save the foot if possible, I directed the leg to be placed on its outside upon a splint, the upper wound to be dressed with lint and warm water, but the lower wound to be left uncovered, a corresponding opening having previously been made in the splint. Very little constitutional irritation followed. The mischief did not extend beyond the part injured: it remained, in fact, quite localised throughout. The articular surfaces of the astragalus and tibia lost their cartilaginous investments; but the child did well, leaving the hospital at the end of four months with a good and useful foot.

Mr. Roberts, of Bangor, who has had great experience in accidents of this description, has kindly favoured me with the following observations:—"I have hitherto been fortunate in treating injuries of the foot, and have succeeded in saving very severe cases. I remove all loose portions of the tarsal and metatarsal bones, and Nature does the rest. However, the people here are very healthy. Every injury of the foot, including amputations, has had a successful termination."

My friend Mr. Walsh, of Worcester, in a case of compound dislocation of the ankle, wherein the end of the tibia, denuded of its periosteum, projected through the wound, removed the end of the tibia on the 2nd September, and the patient left the hospital on the 23rd of the following December, with motion of the joint, being able to flex and extend it at will. He remarks, "If I had removed the articulation of the astragalus, anchylosis would have occurred. The operation may not have been secundum artem, but it is very interesting and instructive." I will not stop here to inquire whether anchylosis would have inevitably followed the removal of the articulating surface of the astragalus; but I entirely disagree with Mr. Walsh in his operation not being "secundum artem." He may well be proud of the operation in itself, as well as of the sound surgery which he evinced in its performance.

I am indebted to Mr. G. W. Rhodes, of Huddersfield, for the following example of "true bloodless conservative surgery." He writes: "The only cases I remember, bearing on your subject, which have come under my care, are a compound dislocation of the ankle in a collier, a compound dislocation of the ankle in a farmer's boy, and a severe crush from a railway engine in a 'pointsman;' all of which have done well, and are now able to walk well. In one of the compound dislocations I had to remove a small portion of the fibula before I could reduce the dislocation, as well as enlarge the opening in the skin through which the bone protruded. The railway pointsman had his toes and metatarsal bones crushed so severely as to raise the question of performing Chopart's operation. I decided, however, to give the man the chance of keeping as much of his foot as possible, and was pleased to find that the toes alone sloughed off, leaving him in possession of a far more useful limb than appeared likely when he first came under notice."

The particulars of the following equally interesting case were kindly furnished me by Mr. Wheelhouse, of Leeds:—J. H. came under his care on the 9th of June, 1864, with a smashed foot. The integuments and subjacent fascia were entirely separated from the muscles of the sole of the foot. Many of the muscles, especially the abductor pollicis, were freely exposed. The finger could be passed from the ball of the toes very nearly to the heel between the skin and the crushed tissues beneath. The scaphoid bone was dislocated; but the plantar vessels were uninjured. Mr. Wheelhouse reduced the dislocated astralagus, and successfully endeavoured to save the foot, the patient making a complete recovery.

Mr. Benfield, of Leicester, has also favoured me with the annexed instructive case:—E. C., aged six years, was run over, and had his foot smashed. The integuments were torn off from the os calcis to the base of the metatarsal bones of the toes, both on the dorsal and plantar aspect. The second toe, crushed, sloughed off. The rest of the foot healed; and at the present time (March, 1866), the child has a useful foot.

When time is not an object, when the patient can be kept completely at rest, can be well fed, nursed, and properly attended to,—disease of the tarsus and metatarsus will frequently do well without any, or with comparatively slight, operative procedure. Keeping the limb upon a splint, laying open the sinuses as they form, the diseased bone will often be thrown off, or, becoming loose and isolated, may be removed with but little difficulty. Months, however, and sometimes years, may elapse before the disease is entirely got rid of by these means. Mr. Morgan, of Bristol, relates the case of a young lady who has thus recovered from necrosis of the metatarsal bones of each great toe. I have myself recently had a similar case. Mr. Partridge has also cured a young lady of disease of the tarsal bones by the same course of treatment.

This practice appears to be of ancient date. D'Armbraste, of Breslau, is stated by Pezolde to have enlarged sinuses either by knife, sponge-tent, or gentian; to have gouged out, applied the actual cautery, or removed the entire bone as required; and he in this way is reported to have got rid of twenty-seven bones from the foot of a girl aged twelve years. Pezolde, however, does not state which of the twenty-eight bones was preserved, nor does he give the result of the case.

Mr. James, of Exeter, in caries of the foot, advises the use of powerful warm douches. In the year 1832 he prevailed upon the governors of the Exeter Hospital to have a proper apparatus erected; and he says, "the constant experience of thirty years justifies him in saying that they possess a very great power of procuring the discharge of diseased bone, and of restoring a healthy state of the soft parts. He admits that he cannot explain how the remedy acts, but he believes that it is from its giving nervous power." It may be so, but its effects upon the bone may be purely mechanical, whilst the restoration of the healthy condition of the soft parts in all probability follows as a matter of course upon the removal of the cause of irritation.

The bones entering into the numerous joints of the foot, all sufficiently loose to admit of a certain amount of movement, but all at the same time so firmly bound together by ligaments as to be unable to accommodate themselves to the tumefaction of inflammation; the numerous tendons, with their sheaths; and the binding down of the whole by dense fascia,—combine, with the consequent tension and irritation, to render comparatively trivial wounds of this part, and, I may say, of joints generally, so much more serious and even fatal in their results. I have already alluded to tetanus following these apparently slight causes, and I would fain inquire what is the best mode of treatment in such cases.

The learned Professor of Anatomy at Cambridge, in his address upon Surgery, delivered before the British Medical Association, in 1864, observed:— "To the practice of administering opium either by the mouth or hypodermically after operations, for the purpose of preventing the pain that is likely to follow them—a practice which has many advocates —I am in most cases decidedly opposed. The immunity from suffering, which, be it remembered, does not by any means always occur, and which improved treatment of the wound will render still less common, is, in my opinion, dearly purchased by the languor and enervation that often follow the opium. As a general rule, I prefer that my patient should run the risk of a sleepless night after an operation rather than incur the effects of the sedative." It is extremely satisfactory to find that one whom we all value and esteem so highly has in his practice enjoyed such immunity from disease and suffering as this doctrine would imply; for I verily believe that no one who can realize the alternative, or who has experienced the tortures of a sleepless night of suffering, the amount of anxiety and irritability in which the long dreary hours are passed, and the consequent languor and prostration which usher in the day, but would gladly barter these for the risks attending the administration of an opiate. I must plead guilty to my opinion and practice being both opposed to this doctrine. I have always regarded pain as the most powerful of all depressing agents, and opium, when given to allay or to prevent pain, in exactly the opposite light. I believe that by preventing or subduing pain we may in a large majority of accidents and operations prevent inflammatory action; and as traumatic tetanus can only be regarded as reflex irritation acting upon the nervous centre, and when once established rarely cured, I have for years impressed upon my pupils the importance of at once placing patients suffering from lacerated or punctured wounds under the influence of opium, varying the dose according to the gravity of the case, the violence of the pain, and governing its continuance by the duration of the adverse symptoms; and certainly, by allaying irritability, this medicine appears to me to exert a most beneficial effect in the perfect rest and quiet which it induces. At all events, since I have adopted this view, I perform fewer operations for such accidents than I did previously.

Dr. Julian Chisholm, of Charleston, U.S., whom I saw at my hospital the other day, informed me that during the early part of the American war they amputated compound fractures of the thigh, but that later it was found that by keeping the patient under the influence of opium they could do away with amputation in these cases; that the mortality was not greater than when amputation was had recourse to; that tetanus was unknown; and that the value of this treatment became so universally recognised that ultimately the medical officers, before going into action, were supplied with opium, which they carried about them and administered to the wounded on the field before their removal to hospital.

But in some instances, do what we will, we cannot arrest the mischief. The most intense pain, with starting and jumping of the limb, ensues; the muscles contract; matter forms in and around the joint; and the patients, worn out by suffering and want of rest, are reduced to the greatest danger: so that too frequently the only alternatives are excision of the joint or amputation of the limb. Might we not here do good by anticipating these serious results—by at once, when we find matters assume a serious aspect, imitating the examples of extensive laceration such as we have just been considering, and thus, by affording a free outlet and doing away with the tension and constriction at one and the same time, prevent the extension of the mischief and relieve the constitutional irritation?

Mr. Hilton, in relating a case of complete dislocation of the foot cured by rest, says: "Here I may add, as matter of interest, that this boy's ankle-joint being completely exposed, I took the opportunity to touch with my finger the exposed inflamed and partially ulcerated articular cartilage. He felt no pain; but when I pressed hard upon either the articular surface of the astragalus or the tibia, it gave him a great deal of pain, clearly indicating that the pain was not associated with simple ulceration of the cartilage, but had reference to the deep pressure upon the subjacent parts." I read these remarks with the greatest interest, as they are borne out by what I had been taught by the late Mr. Lynn, for many years a member of the Council of this College, but who, unfortunately for the progress of surgery, was crotchety, and resolutely refused to publish the results of his vast experience, boasting that he had never written a line for publication in his life. His doctrine was that in ulceration of the ginglymoid joints, whilst the ulceration and consequent pain led in the first instance to the muscular contraction, the muscular contraction, by increasing and perpetuating the pressure, aggravated the pain, and prevented the cure of the ulcer. And I would here observe, that the straightening of contracted joints under chloroform, of which so much has been made by orthopædic surgeons, is neither a new discovery nor a new practice. Certainly chloroform had not then been discovered; but more than thirty years ago it was Mr. Lynn's practice in ulceration of the joint, forcibly to straighten the contracted knees of children, sometimes by gradual, sometimes by more rapid extension and pressure, but generally with the best results, insisting that if the ulcer was relieved from pressure, the cure of the patient would most likely ensue. And, moreover, when ether was first introduced, I successfully treated the contracted knee of a young married woman in the same way; but having frequently done the same upon other patients without the ether, I did not consider the case of sufficient interest to publish it. And my surprise was, consequently, great at finding this plan of treatment soon afterwards imported from Germany as a novelty.

But this case of Mr. Hilton's is not of interest merely as indicating the association of pain, but as pointing out the treatment which may sometimes be adopted with advantage in certain cases of ulceration of the joints, and which, if successful, may supersede the operation of resection. It proves that the suffering is caused by the bones being so firmly bound together by their strong ligaments that they are unable to accommodate themselves to the tumefaction of the soft parts within; whilst this tumefaction and the increased effusion into the joint cause an amount of intra-articular pressure, which, acting upon the ulcerated surfaces, produces that intense suffering so frequently observed.

Mr. Adams, it is true, advocates opening joints when matter has formed therein; and in relating the history of four cases in which he had pursued this treatment, he adds, "When suppuration has taken place, it is absolutely necessary that you should adopt this practice. If you cut let your incisions be free, and do not squeeze; leave the openings patent, and do not bring the edges of the wound together by plasters or bandages. In pyæmia, I especially advise you to make free incisions into the joints wherein abscesses form. The result of my experience is that by this treatment many lives are saved."

Mr. Gay also, in 1852, in advanced cases of joint-disease involving destruction of cartilage, recommended deep incisions on either side of the joint, so as to lay it open freely in the long axis of the limb, and extend it into the abscess in the soft parts. If the bones be carious or necrosed, the incisions should be carried deep into such bones, so as to allow the dead particles of bone to escape. Ligaments which stand in the way of a free discharge from the joint should be cut through.

Nothing can be more practical or judicious than the observations of both Mr. Adams and Mr. Gay; but, as you will have observed, they only apply to cases wherein suppuration has already taken place, and the main object is to get rid of the matter; but in very many instances which engage our attention in hospital practice, although there is no suppuration, still the suffering from pressure and gradual destruction of joint-tissue so undermines the patient's constitution that we are constrained to excise the joint or amputate the limb to save the patient's life.

Recollecting, therefore, the precepts of Mr. Hilton and of the late Mr. Lynn, I cannot help thinking that in this large class of cases we might stop short of actual excision of the joint, and at the same time arrest the sufferings of the patient by making subcutaneous sections of the ligaments of the joint, and, if necessary, of the principal tendons, by which means tension would be removed, and the joint thus freed from pressure and placed at rest, would have a far better chance of recovery.

LECTURE III.

TIBIO-TARSAL OR SYME'S AMPUTATION.

MR. PRESIDENT AND GENTLEMEN,

Mr. Syme in the year 1842 introduced to the notice of the profession an operation described by M. Jules Roux as destined "to modify without changing the language of nature." The operation in question is essentially a scientific and philosophical proceeding, the result of study and appreciation of parts and of their particular structure and functions; since, by the ingenious employment of natural material, it seeks to supply that which it removes, and to enable the patient to bear the whole weight of his body upon the face of the stump, and to employ it, so to speak, as a foot. The non-appreciation of the true objects of this operation has led surgeons abroad to treat Mr. Syme with but scant justice in their endeavours to deprive him of what is justly his due, the merit of originality. We are told, for instance, that Sédellier was the first to perform it, about the middle of the last century, upon a child, aged ten, for traumatic gangrene; that very little inflammation or suppuration followed; that the cartilaginous surfaces did not exfoliate; and that the wound healed in a short time, and did not reopen. We are told also that the operation appears to have been indicated by Hippocrates when he wrote "Resectiones ossium perfectæ circa articulos et in pede et in manu et in tibia ad malleolos." That Fabricius de Hildanus performed the operation several times. That Brasdor contributed the first well-authenticated case. That it was also performed by Rossi and Sabatier, and especially by Baudens, to whom the credit is given, not only of establishing the operation in France in the year 1839, but of having his example followed in England by English surgeons, especially by Mr. Syme; and subsequently in Germany by Heyfelder, Textor, junr., Chelius, and several others; and of late years in France by Sédillot, Blandin, Jobert, &c., &c.; whilst it is added, "Syme described his operation in 1832, but Malgaigne, in the first edition of his 'Traité de Méd. Opératoire,' explicitly recommended the formation of a flap from the skin of the heel and resection of the malleoli."

In justice to Mr. Syme, I would analyze the correctness of these assertions, and endeavour to ascertain and prove in what manner and to what extent the proceedings of the surgeons here mentioned have anticipated the ideas and performances of Mr. Syme as regards this operation.

I cannot get at a copy of the first edition of Malgaigne's "Operative Surgery;" but if, in his first edition, he recommended the formation of a flap from the skin of the heel, and resection of the malleoli, he, undoubtedly, abandoned such recommendations in his second edition, wherein, under the title of Tibio-Tarsal Amputation, he restricts himself to the following observations:—

"Although generally rejected nowadays (tibio-tarsal amputation), it is recognised by several surgeons. Lisfranc, Velpeau, and even the prudent Sabatier, express regret at the oblivion in which it is plunged. Velpeau proposes to make two semi-lunar cuts at twelve or fifteen lines in front of and behind the articulation, and to unite them by two lateral semi-lunar flaps, one on each side, about an inch below the malleoli. Having retracted the skin, he cuts through the soft parts, and disarticulates the foot; afterwards uniting the wound from before backwards. If the malleoli interfere with union, there is nothing to prevent their removal."

Malgaigne adds: "A careful consideration of the anatomy of the joint, and the difficulty of providing the patient with a suitable stump, have led us to the following conclusion:—That the amount of unfavourable circumstances attending this operation so very much exceeds its advantages, that we shall altogether reject it."

It is also difficult to understand how Hippocrates can be said to have indicated this operation. The words quoted form part of the sixty-eighth paragraph of the section on Articulations, which has been thus rendered by the learned translator, Dr. Adams:—"When the articular bones of the fingers are fairly chopped off, these cases are mostly unattended with danger, unless deliquium comes on in consequence of the injury, and ordinary treatment will be sufficient in such cases. But when resection is made, not at the articulations, but at some other point in the bones, these cases also are free from danger, and are still more easily cured than the others; and the fractured bones of the fingers, which protrude otherwise than at the joint, admit of reduction without danger. *Complete resections of bones at the joints, whether the foot, the hand, the leg, the ankle, the forearm, or the wrist,* for the most part are not attended with danger, unless one be cut off at once by deliquium animi, or if continual fever supervene on the fourth day." I give this paragraph *in extenso*, because, according to the learned translator, it contains almost all the information on the subject to be found in the works on ancient medicine. Celsus, noticing the practice very briefly, observes: "Si nudum os eminet, impedimentum semper futurum est; ideo quod excedit abscindendum est." Clearly there is no indication of Syme's operation here.

Brasdor, according to Boyer, sacrificed the heel-structures altogether. He cut through the soft parts from behind forwards to below the malleoli, then entered the joint, and disarticulated the foot. Rossi made two lateral flaps, to which Velpeau objects that they do not fall so well into the intermalleolar space as the anterior and posterior flap. Sabatier proposed circular amputation, although neither he nor anyone else ever performed it; whilst Boyer remarks, "They have also proposed to saw off the malleoli immediately above their bases, and this method [disarticulation of the foot] has been thought preferable to amputation of the leg, but the advantages they present are not sufficient to do away with amputation in their favour."

Now turn to the operation of M. Baudens, whose example Mr. Syme is stated to have followed, and see how that statement is supported. M. Baudens makes an incision extending from the posterior surface of the os calcis to near the metatarso-phalangeal articulations passing along the borders of the foot. The flap thus formed is dissected back to the tibio-tarsal joint. The saw is then applied, and the lower portion of the tibia with the malleoli are removed, leaving an even surface. The soft parts are then cut through from before backwards with a knife, care being taken to preserve the tendo Achillis as long as possible. The flap, then turned downwards and backwards, is maintained *in situ* by sutures.

Thus Baudens obtained his flap from, and covered the cut ends of the bones with, the delicate skin of the dorsum of the foot, but he never contemplated the possibility of his patients being able to walk upon the stump thus made.

In these important points consists the marked distinction between the operation of Baudens and that of Syme, whilst the originality and philosophy of the latter method are at once apparent. By it Mr. Syme provides not only for the patient walking on the stump, but for his walking also upon structures originally supplied by nature for that purpose, viz., the integuments and cushion of the heel.

But let Mr. Syme describe his own operation (Principles of Surgery). "The foot," he says, "being held at a right angle to the leg, the point of the knife is introduced immediately below the malleolar projection of the fibula, rather nearer to its posterior than anterior edge, and then carried across the foot, slightly inclining backwards, to the inner side of the ankle, where it terminates at the point exactly opposite its commencement. The extremities of the incision thus formed are then joined by another passing in front of the joint. The operator next proceeds to detach the flap from the bone, and for this purpose, having placed the fingers of his left hand over the prominence of the os calcis, and inserted the point of his thumb between the edge of the plantar incision, guides the knife between the bone and nail of the thumb, taking great care to cut parallel with the bone, and to avoid scoring or laceration of the integuments. He then opens the joint in front, carries his knife outwards and downwards on each side of the astragalus, so as to divide the lateral ligaments, and thus completes the disarticulation. Lastly, the knife is carried round the extremities of the tibia and fibula, so as to afford room for applying the saw, by means of which the articular projections are removed, together with the thin connecting slice of bone covered by cartilage. The vessels being then tied, and the edges of the wound stitched together, a piece of wet lint is applied lightly over the stump, without any bandage, so as to avoid the risk of undue pressure in the event of the cavity becoming distended with blood, which would be apt to occasion sloughing of the flap. When recovery is completed, the stump has a bulbous form, from the thick cushion of dense textures which covers the heel, and readily admits of being fitted with a boot."

If we contrast this with the proceedings of other surgeons already described, the only conclusion at which we can arrive is, that although Syme may have been anticipated as to *locality*, his operation was entirely original, both as regards the objects for which it was proposed and the mode of its performance.

As to his objects also let him speak for himself:—"The advantages which I originally anticipated from this operation were—first, the formation of a more useful support for the body than could be obtained from any form of amputation of the leg; and secondly, the diminution of risk to the patient's life, from the smaller amount of mutilation, the cutting of arterial branches instead of trunks, the leaving entire the medullary hollow and membrane, and the exposure of cancellated bone, which is not liable to exfoliate like the dense osseus substance of the shaft, and that the operation may be regarded as almost entirely free from danger to life. It also has the grand advantage of removing, not only the bone already diseased, but the whole of that spongy portion which may be disposed to suffer in the same way, as not unfrequently happened after the operation of Chopart."

As may be supposed, an operation based upon such new principles, and ushered in by the prestige of its proposer, met with many admirers, and not a few opponents. Of the former—amongst whom we may reckon Sir Henry Thompson, Messrs. Busk, Pemberton of Birmingham, Page of Carlisle, Lowdell of Brighton, and others, no one has welcomed it in a more just and liberal spirit than M. Jules Roux, who performed it for the first time in 1846, and who has advocated its advantages in the following terms:—"It appears to me that by this operation art modifies without changing the language of nature; in fact, the malleoli being removed, the lower extremity of the leg affords a base of support which transversely exceeds that of the os calcis."

On the other hand, very serious objections have been urged against it—violent inflammation extending up the leg; sloughing; secondary hæmorrhage;

death immediately dependent on the operation; tardy healing of the wound, and defective condition of the stump from languor of circulation; and tenderness, so that it could not be pressed upon or made useful—have all been laid to its charge. These it must be confessed are most grave and important objections; for if the operation is really and unduly obnoxious to them, the question for us to consider is, not the mere relative value of the proceeding, but its absolute and entire rejection.

In pursuing the inquiry, I would confine myself to the charges themselves, and to the simple and broad question, Is the operation a good operation and worthy of adoption, or is it not?

"Violent inflammation extending up the leg" certainly occurs, but scarcely to the extent imagined, if I may judge from the notes before me. I have here the particulars of some 219 cases, irrespective of those operated upon by Syme himself; and in only four instances has any allusion been made to it. It has, doubtless, happened much more frequently than this; but not, it would seem, with sufficient severity to be deemed worthy of especial notice. And, even in those cases related, it would be difficult to say that the symptoms were due to the peculiarities of the operation, or that they would not have occurred equally had any other operative procedure been adopted.

Take the following case, for instance:—Shortly after the operation a little oozing of blood; additional pressure applied over stump; limb rolled up to knee with moderate tightness, and steadily fixed; a firm compress over the tibial artery where it comes off from popliteal, which was retained by a few turns of bandage somewhat tighter than the rest. Three days after, lymphatics up to groin inflamed. Fourth day, phlebitis. Sixteenth day, large abscess at back of leg. Tenth week, stump healed. Three weeks later, large abscess below tendo Achillis. Three weeks later still, another large abscess.

Take another example, in which the operation was followed by erysipelas, succeeded by prolonged suppuration and pyæmia, the deposit of matter in the knee-joint necessitating amputation of the thigh.

These are two of the cases to which especial allusion has been made, and they certainly do not present any distinctive peculiarities from what frequently occurs after other operations, and which may reasonably be accounted for by constitutional wrong, by phlebitis, or by the absorption of some animal poison, such as decomposed blood, into the system.

Suppuration in the course of the tendons and on the surface of the stump is of much more frequent occurrence; but however this is to be deplored as retarding the cure, it does not exert much influence over the mortality of the operation, since, of the 219 cases, not one is reported to have terminated fatally from this cause.

It seems to me very doubtful, after all, whether the suppuration may not reasonably be attributed to other causes than to the operation—to error in the dressing of the stump, for instance. I do not attach much weight to the opinion that this suppuration is caused by the tendons being cut too short, and receding into their sheaths, and that by cutting them longer we may prevent it. I do not understand why the end of a tendon, if divided by a clean cut, is less likely to inflame and cause suppuration when involved in the wound than when enclosed within its natural sheath. I believe that more mischief ensues from closing the wound too completely; from tying the sutures too tightly, and not taking sufficient care to include nothing but skin in the sutures; for, by passing the latter through the sheaths of the tendons, we thus introduce a seton, we create inflammation, and we can scarcely be surprised at the suppuration. When the flaps are brought too closely together there is no outlet for the blood, which in most cases oozes from the cut surfaces of the bones and soft parts. This, collecting in the hollow of the flap, causes tension, pain, and inflammation; whilst the liability of its decomposition and absorption involves the risk of pyæmia, as we have seen in the cases related.

It is more prudent, therefore, to follow Mr. Syme's example, and not to dress the wound or bring the flaps together until all oozing has ceased; and when we dress the wound, only to close it in front, leaving its lower angles open, thus affording a depending exit for any secretion, whether of pus or blood, which might otherwise collect. We should never attempt to prevent bagging of the flap or the accumulation of blood, &c., by what is called *supporting* the posterior flap, or, in reality, by pressing it against the cut surfaces of the bones. This is very liable to cause sloughing, not only by the direct pressure exerted, but by the base of the flap being forced against the sharp posterior edges of the cut bones; the flap and the blood-vessels are thus bent at so acute an angle that the circulation of the flap is impeded, if not completely obstructed, and sloughing of a portion or the whole of the flap is a probable result.

Sloughing is another adverse circumstance attributed to this operation, but *its* dangers also appear to be overrated. In the *Monthly Journal of Medical Science* of July, 1852, we are told that Mr. Syme performed the operation fifty times without any mortification of the stump. Of the 219 cases already noticed, sloughing of the flaps is alluded to in sixteen. Of these sixteen, secondary amputation was performed in three, the primary operation in one having been for traumatic gangrene, whilst in the other two the whole posterior flap had sloughed away. The remaining thirteen recovered with good and useful stumps, at periods varying from three to twelve months. In no single instance do I find death attributed to this cause.

In criticising the merits of a particular operation distinguished moreover by its author's name, we should be careful to ascertain whether, in the examples whence we draw our conclusions the directions laid down by such author have been implicitly followed; for when a surgeon indulges in what he calls a modification, it is obvious that the individuality of such operation is lost, and that the modification, whether successful or not, is of but little value as evidence either for or against the merits of the original proceeding.

If I propose to perform Syme's, Pirogoff's, Chopart's, or any other surgeon's particular operation, and, instead of adhering to the plan of proceeding laid down, neglect some point or indulge in some variation which I may deem an improvement, and my experiment fails, it is unreasonable to connect such failure with the original operation, and still more so to adduce such failure as evidence against it. Nevertheless this has been done upon more than one occasion with respect to the method now under consideration. For instance, it is stated in one of the medical journals for the year 1857 that the late Mr. Stanley amputated the leg of a sailor upon whom Syme's operation had been performed by a Russian surgeon at Sebastopol, and who could not bear the pain in the stump. The cicatrix was in the hollow of the stump between the malleoli, which had not been sawn off. The injury was from an exploded shell; and the coverings of the stump had not been taken from the heel, but apparently wherever they could be obtained. We may fairly ask, In what possible respect does this case resemble Syme's operation ?

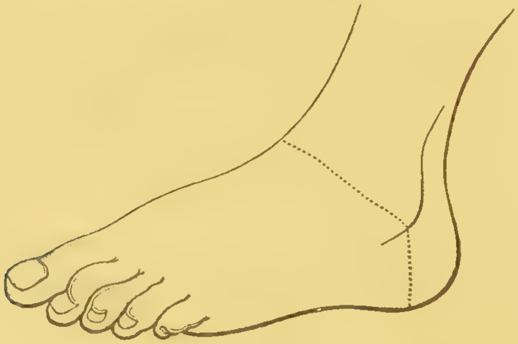
Again, Mr. Butcher reports a case in which he found it necessary to perform amputation of the leg some months after Dr. Bellingham had performed amputation of the ankle-joint upon the same patient. The man had never been able to bear the least pressure on the stump, though on his discharge it had promised all that could be desired. The cicatrix was not only painful, but ulcerated; and, to complete his wretchedness, the cut extremity of the nerve, on the inner side, was a source of acute suffering on pressure. Mr. Butcher dissected the stump, and found that inflammation, terminating in ulceration, had attacked the cartilage over the articulating surface of the tibia, and that the extremity of the nerve was in a bulbous condition, being expanded to the size of a large almond; and hence Mr. Butcher arrives at the conclusion that the operation is not applicable to the labouring man.

If this was a frequent result of the operation, I should doubt its applicability to any class of patients. But, in the first place, Dr. Bellingham did not perform Syme's operation at all, but a modification of his own. Mr. Syme especially directs not only the removal of the malleoli, but also a thin slice of the tibia involving the articular cartilage; so that had his directions been followed, no cartilage would have remained either to have inflamed or ulcerated. And, in the second place, Mr. Butcher would seem to imply that the bulbous condition of the nerve was in some way or other peculiar to this proceeding; but it occurs equally in other amputations. Some years back I removed the arm at the shoulder-joint for this cause. The patient had twice undergone amputation in the continuity of her forearm and arm at another hospital before she came under my care for intense suffering in the stump. I dissected out the enlarged bulbous extremity of the median nerve about an inch and a half long, but without doing any good, as another bulb formed soon after, and produced so much suffering that, at her own request, I removed the arm at the shoulder-joint, when her sufferings ceased.

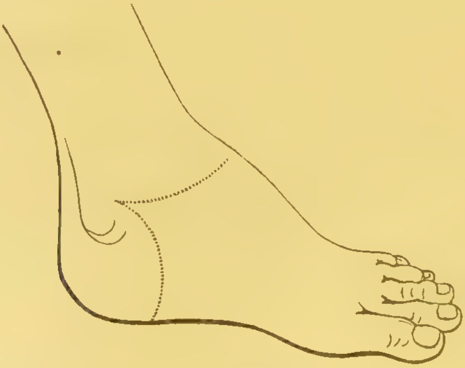
To apply these remarks still further to Syme's operation: Mr. Syme *insists* upon the lower flap being made of a particular size. He says: "The incisions *must* be correctly made. A transverse one should be carried across the sole of the foot from the tip of the external malleolus, or a little posterior to it (rather nearer the posterior than the anterior edge of bone), to the opposite point on the inner side, which will be rather below the tip of the internal malleolus. If the incision be carried further forwards considerable inconvenience is experienced from the greater length of the flap, and I believe that a great deal of difficulty that has been attributed to the operation has arisen from this source. The operator, getting into the hollow of the os calcis, cuts and haggles in striving to clear the prominence of the bone."

The annexed woodcuts show the relative size of the posterior flap as recommended by Syme, Sir W. Fergusson, and Miller.

It would seem that surgeons, even when writing especially upon this operation, entertained any but correct ideas as to the proper dimensions of the posterior flap. Mr. Syme has kindly presented me with a copy of a treatise, "De Amputatione in Articulo Pedis," written as early as two years after Mr. Syme published the account of his method, viz.,

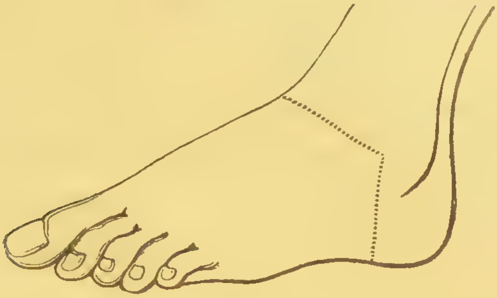


Syme.



Sir W. Fergusson.

in the year 1846, by Dr. Francis Chelius, of Heidelberg, and I find, although the Doctor visited Edinburgh for the express purpose of studying the operation, that he delineates the posterior flap as commencing from the anterior instead of the posterior angle of the malleolus as taught by Mr. Syme.



MILLER.

To obviate the bad effects resulting from the confinement of matter, Mr. Quain makes a horizontal incision in the posterior flap, whilst in a letter to Dr. Farquharson, dated June 9, 1866, Mr. Syme writes, "I think it a good plan to make an opening at the posterior and thinnest part of the flap large enough to admit the finger, to serve as a drain for the matter, and if the ligatures are taken back through the aperture they prevent it from closing. The incision for this purpose should of course be in the longitudinal line;" whilst he continues, "As to the dressing, I have merely to say that it consists in dry lint and a piece of bandage about a foot and a half long. This being split up about half its length, the two narrow ends are tied round the ankle and then to the broad one after it is brought up over the stump."

Mr. Benfield, of Leicester, also writes me, "A depending opening in the stump is a most important requisite for a readily healing cushion." Whilst Mr. Tudor, of Dorchester, remarks, "I remember to have been very pleased with the rapidity of the healing in the 'Syme's case,' which I attributed in a great measure to a free opening in the flap in consequence of a coalescence of three sinuses behind the line of incision through which the discharge passed off."

Another point upon which Mr. Syme lays great stress is, "that in separating the flap of skin from the os calcis we must cut parallel to the bone. This is of the greatest importance, since, when the flap is detached from the bone, its only supply of nourishment must be the branches which run through it parallel to the surface; and if, instead of keeping parallel to the surface, you cut on the flap, you will, by scoring it, in this way necessarily cut through these branches. I have reason to know that the sloughing which has occurred in some cases has been due to these defects in the performance of the operation."

Thus we see that Mr. Syme insists most strenuously upon these two points—viz., making the flap of a given length, and dissecting this flap parallel and not transversely to the bone, whereby we avoid cutting the bloodvessels across; and that he as strenuously asserts that the sloughing of the posterior flap has been due to their neglect. It may be as well to inquire whether there is any, and what, importance to be attached to his second point.

The plantar flap is supplied from the—

1. External calcaneal termination of the peroneal, which runs along the external edge of the tendo Achillis, to which it sends branches.

2. Posterior tibial, which, before dividing into the two plantar, gives off five or six important branches to the integuments behind the heel.

3. Branches from the malleolar, which, after running on the sides of the foot, become lost in the fat of the heel.

4. Internal and external plantar, which supply numerous branches to the point of the flap. These, from ten to fifteen in number, supply the muscles and integuments of the sole of the foot.

Hence the plantar flap is supplied principally by the external calcaneal, by branches from the trunk of the posterior tibial, and by branches from the malleolar, especially the external. So that, whilst it derives its principal supply from the posterior tibial, it is not entirely deprived of blood when this vessel is cut through above its bifurcation, since the inosculation between the branches given off before its division, with those of the peroneal, and the supply of blood furnished by the peroneal artery itself, have been found sufficient to preserve the vitality of the greatest portion, if not of the entire flap, when this accident has unfortunately happened. And this accounts for the success attending those operations where, as appears in more than one part of my correspondence, "we frequently cut through the posterior tibial artery before its bifurcation." But whilst it proves that the flap does not depend exclusively upon the posterior tibial artery for its nourishment or vitality, it also incontrovertibly proves the value of Mr. Syme's second point, and the importance of preserving, not the main trunks only, but also their small branches distributed to the flap itself.

Another objection to the operation is its fatal termination—"death immediately depending on the operation." We may reasonably suppose that this implies *frequent*, not isolated, examples of fatal termination traced directly to the operation.

To test the validity of this objection, compare the mortality attending this operation with that said to follow amputations of the leg; and refer to a valuable paper read before the Medico-Chirurgical Society, by Mr. Bryant, in the year 1859, "On the Causes of Death after Amputation," the author basing his calculations on 300 cases, of which 81 were of the leg. He gives the gross mortality of amputations of the leg at 37 per cent.; the mortality after operations for disease being 7·7 per cent.; after accidents, 62·5 per cent.

Let us now return to our table. Here we find 205 cases of Syme's amputation, performed by British surgeons, of which the gross mortality is 17, or rather more than 7·11 per cent., as against 37 per cent. in the leg. 181 operations were performed for disease. Of these 11 died, or 6·10 per cent., as against 7·7. 32 were for accidents; of these 6 proved fatal, or about 19 per cent., as against 62·5 in amputations of the leg. These data are so conclusive that any further remarks would be superfluous, since, granted that death is to be traced in some instances directly to the operation, the same may be urged against any and every description of major operation performed.

Mr. Butcher, of Dublin, in his "Reports on Operative Surgery," says:—"Upon serious reflection, I have no reason to alter the opinion I expressed many years ago, that Syme's operation is not applicable to the humble labourer and artisan." He seems to have drawn his deductions, at all events at this period, from two very exceptional cases: one in which the patient, after considerable suffering from implication of the nerve in the stump, went mad; and the other in which, after attempting Pirogoff's operation, he substituted that of Syme, the patient being only saved from death from pyæmia by the great skill and attention of this eminent surgeon.

Mr. Haynes Walton, in 1857, could not conscientiously recommend this operation. He knew that the stumps looked well, but had never met with one that was useful. In all, the under surface of the stump had remained too tender to allow of pressure upon it, and more than once amputation through the lower third had subsequently to be done. The great error arose from surgeons not watching these cases after they left the hospital. He had seen three cases upon whom Sir William Fergusson had operated at the ankle-joint, and, although the stumps were models, not one could walk with comfort. He thought the operation would eventually be abandoned.

In 1851, Sir W. Fergusson, who was then the warmest advocate of this proceeding, declared "he had no hesitation in saying that the stump was the best that can be made in the lower extremity." It is true that Sir William in 1857 saw reason to retract this opinion, and in all probability the three cases alluded to by Mr. Walton may in some degree have conduced to the change.

Of the 219 cases, to which I must again refer, 183 are reported to have recovered with useful stumps. And as regards Mr. Walton's assertion, that surgeons do not watch their cases after leaving the hospital, I would cite the patients operated on by my late colleague, Mr. Avery, and by Mr. Wilkinson, of Hartlepool. Mr. Wilkinson kindly writes me, in reply to my inquiries: "The young man recovered his health and strength. He had a mechanical foot fitted, also a padded spring on the inside of the heel of his boot, and was thus able, without even the aid of a stick, to walk several miles without fatigue or inconvenience, and his lameness not perceptible to a casual observer."

Again, Mr. Burford Norman, known to most of us, and now residing at Southsea, writes: "I was consulted about the case, and advised Syme's operation, which was done, and resulted, after a rather tedious process of suppuration, in a very useful stump, upon which the young man now, after more than five years, walks and works like another man."

Mr. Syme gives the condition of three patients upon whom he had operated respectively fourteen, ten, and three years previously. All were in excellent condition, and could stand and walk several hours daily without inconvenience.

Mr. F. P. Lansdown, of Bristol, sends me, among others, the particulars of three cases, in one of which the patient was walking about in six months, another had been walking about freely for two years, whilst the third had for four years generally walked ten or twelve miles a day.

Mr. Wordsworth, with especial reference to Mr. Walton's strictures, reports the case of a girl upon whom he operated for Syme in 1854, and who in 1857 could walk some miles with ease; also that of a guard on the Eastern Counties Railway, who twelve months after the operation was very active, and walked perfectly.

Mr. Athol Johnson relates a case in which the condition of a child three and a half years after the operation was excellent.

Take, again, the interesting and extraordinary case published by Mr. Pemberton, wherein he performed this operation upon a child twelve months old. The child recovered in seven weeks. It must be borne in mind, Mr. Pemberton justly observes, that this child had to undertake her first lesson in walking with a stump, and yet she was able to walk well twelve months afterwards.

In a second case Mr. Pemberton reports the patient, two years and seven months after the operation, to be walking considerable distances without fatigue. Whilst in a third the patient bore pressure two months after the operation, and subsequently worked at an engine foundry for many months without inconvenience.

Mr. Field, of Brighton, performed this operation on a man in the year 1852 for strumous disease of the astragalus and cuboid. Six years afterwards the patient wrote from Australia, stating that he never felt the loss of the limb; that although the roads were very rough, he walked on an average seven miles a day, and had walked fourteen.

Dr. Monro Moffatt says, in reply to Mr. Walton: "I have seen a good number after operation; not one, as far as I can remember, complained of tenderness or unpleasant feeling in the stump. I operated myself, four years ago, on a woman for railway accident, on one foot Chopart's, on the other Syme's. I often saw her afterwards able to move about and see after a little shop, without crutches or any other supports save boots made on purpose. She says that the stump of Syme's operation is the best of the two, and that from the time of her beginning to walk, two months after the operation, she has not had the slightest pain, or inconvenience, or unpleasant feeling in the stump.

Mr. Walker, of Peterborough, has kindly furnished me with the particulars of the following very interesting and conclusive proof of the value of this operation. He says—May 11, 1867,—"Having by chance seen the patient the other day, I got the following information from him:—J. J., aged 16, was operated upon on the 15th December, 1858, by my father, for injuries sustained by the wheel of a railway truck passing over his foot. There was not union by the first intention, some portions of the flap which had been injured sloughing; but, notwithstanding, within a year of the accident the patient walked twenty miles at a stretch on the stump, wearing only a thick-soled boot; he constantly takes long walks, the longest being thirty-six miles, which he walked once, leaving Gloucester at twelve on Saturday night, and reaching Chippenham at ten the next night. He had an artificial foot, but finding he can walk so much better on the stump he has entirely given it up."

Mr. John Hamilton, of Dublin, reports the result of a case operated upon six years previously:—"The man can run with great rapidity, and is in the habit of exciting sympathy by dancing on the stump, which has now lost its roundness, and resembles the heel of a healthy foot."

Mr. Vincent Jackson, of Wolverhampton, informs me that a boy patient of his could bear the weight of his body upon the stump five weeks after the operation, and that now, with a properly adapted boot and foot-piece, it is difficult to see, from the manner in which he progresses, that he has suffered amputation. Mr. Quain kindly writes me word :—" Both the cases published by Mr. Vincent Jackson, my then house-surgeon, in 1857, have been seen by me since—one often. He serves an ice cart about town, and bears heavy burdens; springs up and down to his cart with ease. I have seen him often, and within a few months. The other was sent to me last year by Mr. A. Shaw, who observed him at Middlesex Hospital, where he appeared for some other ailment. Mr. Shaw thought the result of the operation so good that he directed the man to call on me. Since the operation he has been a carrier, walking long distances, and at times bearing burdens."

Mr. Henry Smith also sent me up a patient upon whom he had, a few months previously, performed Syme's operation. The patient had come up to London to have a boot fitted. Certainly the stump was one of the most perfect I have ever seen; it could not have been better.

Mr. Holmes Coote objects to Syme's amputation, not merely on account of the troublesome dissection of the posterior flap from the os calcis, but because it leaves an awkward sort of stump for the boot—*i.e.*, *broader below than above.* If amputation is performed at the lower third or fourth of the leg, the stump is conical and fitted to slide into an artificial limb. In Mr. Syme's proceedings the stump is formed in such a way that the boot must be made to lace up.

Mr. Henry Lee makes a similar objection; and, in reference to a patient upon whom he performed Syme's amputation twelve years ago, says:—"He has all along complained of the thickness of the lower extremity of the tibia, which prevents him putting his stump into any boot that is not too large for the leg above. In fact, he is obliged to wear a laced boot. Otherwise he is very comfortable. In consequence of this difficulty after Syme's operation, I have lately preferred amputating a little higher up, which I have usually done by a long rectangular flap from the *back*."

The late Mr. Teale, of Leeds, on the other hand, when Syme's amputation was first brought out, operated a few times with good results, but for several years has performed rectangular amputation immediately above the ankle—the long flap, containing skin, muscles, and tendons, being taken from the *dorsum* of the foot. He says: "As far as I have seen, the operation is less severe to the system than Syme's: there is less suppuration, and the healing is more rapid; moreover, the resulting stump is excellent. We had one young man at the hospital who used to amuse the students by dancing on the end of his stump."

The last objections I have to notice are the difficulty of performance of Syme's operation, and the slowness of recovery.

The difficulty is much diminished by restricting the size of the posterior flap to that so forcibly insisted on by Mr. Syme. By so doing we not only diminish the amount of flap to be dissected from the os calcis, but we also avoid the risk of cutting into the medio-tarsal joint, thus detaching the front of the foot from the os calcis and astragalus, and destroying the facility of manipulating the foot. The incisions having been made through the skin, the posterior flap should be dissected on either side from the os calcis from above downwards, and the lateral ligaments of the tibio-tarsal joint cut through as soon as possible. We are thus enabled to draw the foot, and consequently the os calcis, forwards, and the division of the tendo Achillis and the detachment of the skin from the heel-process are thus facilitated. By preserving the integrity of the medio-tarsal joint, the surgeon is enabled to turn the foot in any direction that he may desire; and when manipulating on the inner side of the os calcis, by keeping the knife well in the hollow of the bone, he easily avoids the posterior tibial artery; whilst, having completed the dissection of the flap from the lateral and under-surfaces of the bone, he completes the operation by cutting through the tendo Achillis, and separating the integuments from the heel-process. All stretching and pulling upon the posterior flap are thus avoided, as the detaching of the foot is effected by the drawing forwards of the latter, and not by the turning back or reflexion of the former—a matter worthy of consideration, since, without doubt, sloughing and suppuration are liable to occur from such a mode of procedure.

With regard to the slowness of recovery, we should bear in mind the class of diseases and the nature of the accidents for which Syme's operation is performed. When we consider the scrofulous, broken-down constitution on the one hand, the contused, crushed, and lacerated wound on the other; and, moreover, the anatomy of the part for which and in which it has to be performed,—we can scarcely be unprepared for the complications which arise during the progress of recovery. Granted that these may to a certain extent, in accidents more especially, be avoided by operating at a greater distance, through structures uninfluenced by the direct effects of such accident, and more disposed to heal quickly. But, setting aside the greater shock resulting from amputation through the upper third of the leg, the question still forces itself upon us—Is it or is it not our duty, even though the cure may be protracted, by preserving an increased and almost normal length of limb, to afford our patient a stump pronounced by one of our highest authorities to be the best that can be made, and to enable him to walk upon that stump, instead of condemning him for life to the use of a wooden leg? Unfortunately, my friends have not favoured me with their experience on this point so fully as upon some others. However, I am enabled to give the results of forty cases.

In	1	the cure	was	effected in	3	weeks.
,,	4	,,	,,	,,	5	,,
,,	6	,,	,,	,,	6	,,
,,	5	,,	,,	,,	7	,,
,,	6	,,	,,	,,	8	,,
,,	1	,,	,,	,,	9	,,
,,	3	,,	,,	,,	10	,,
,,	3	,,	,,	,,	12	,,
,,	1	,,	,,	,,	14	,,
,,	1	,,	,,	,,	15	,,
,,	3	,,	,,	,,	16	,,
,,	1	,,	,,	,,	20	,,
,,	2	,,	,,	,,	24	,,
,,	1	,,	,,	,,	32	,,
,,	1	,,	,,	,,	36	,,
,,	1	,,	,,	,,	52	,,
	40					

In some exceptional cases the operation has been followed by severe pain and irritation of the nerves, so severe, indeed, as to induce tetanic convulsions.

Mr. Butcher, in the *Dublin Quarterly* of 1859, relates the case of M. E., aged 45, who suffered intense pain after the operation. Six weeks afterwards an abscess formed in the stump, followed in two days by great pain up the leg in the course of the nerve, but the patient left the hospital three months after the operation. After an absence of three months, she returned to the hospital on account of pain and discharge from the stump. Mr. Butcher made an incision through the whole thickness of the stump to a sinus, laying bare a thick fibrous structure which he dissected out, and it proved to be an expansion or new formation incorporated with the fibrillæ of the anterior tibial nerve. The wound healed rapidly, and she returned home. Soon afterwards she was again seized with pain, and before long she was mad, and when subsequently taken to the hospital, in all her paroxysms referred to the pain in the stump.

Mr. Lansdown, of Bristol (*Lancet* 1848, v. 2), gives the case of M., aged 22, upon whom he performed Syme's operation, 25th October, 1847, for caries of the tarsus of two years' duration, involving the whole of the bones. Nov. 7th, the edge of the posterior flap threatened to slough, and tetanic symptoms began to manifest themselves. Nov. 17th, the tetanic symptoms increased to this date, when a large portion of the sloughed heel dropped off; and from this date to the 1st of December, the spasms gradually diminished until they ceased altogether. When he left the hospital the integuments nearly covered the stump, and he ultimately recovered completely, being able to walk well. Mr. Lansdown attributed the recovery of his patient to his having been, from time to time, placed under the influence of ether.

Dissections.—The particulars of dissection of the stump, resulting from Syme's amputation, have been recorded in two cases only: one by Mr. Butcher, of Dublin, the other by Mr. Curling.

Mr. Butcher reports: "The insertion of the tendo Achillis was so closely applied to the plantar fascia, that it presented the appearance of dividing into three dense fibrous bands passing from behind forwards to the cicatrix. On examining the latter, the anterior extremity of these fibrous bands, or three divisions of the plantar fascia, were fused into the cut extremities of the flexor tendons, the union between them being short and decided; and hence the improbability that the cicatrix would have descended any more by the action of the extensor muscles."

Mr. Pemberton considers that this case proves beyond dispute the permanency of the line of cicatrix, since the tendons in front coalescing with the antagonizing structures behind, an equilibrium of tension in regard to the cicatrix is the result. In all probability this may be the case in many instances, but we cannot arrive at any certain conclusion from one example only, especially as in Mr. Curling's dissection we search in vain for any such arrangement of parts.

Mr. Curling's dissection is that of the stump of a young man, who, when a boy aged seven, had his foot crushed by a brewer's dray on the 5th of April, 1852. The parts healed favourably, and the boy was able to walk on the stump for two years. The limb was amputated eleven years afterwards for disease of the knee-joint. A vertical section was made through the tibia and stump. The bellies of the soleus and gastrocnemius were converted into fat; the lesser muscles were not so completely converted, but here and there contained pale tawny muscular fasciculi. The tendo Achillis was much thinner than is usual at eighteen years of age, and, traced into the stump, it ended in a patella-like disc of bone, which, fixed below, glided freely, by means of a bursal surface, against the blunt and rounded posterior edges of the lower ends of the tibia and fibula. This patella-like bone measured an inch and a quarter in length, three-quarters of an inch in width, and at its centre half an inch in thickness, and was composed of cancellous bone, bounded by a thin lamellated surface. Its long axis was horizontal; its posterior margin strongly convex; its anterior concave, both in the vertical and horizontal directions. It thus accurately fitted against the posterior surface of the tibia, on which it played. The fibres of the tendo Achillis spread out as they approached this bone, and then invested it on all sides, becoming incorporated with its periosteum. From the lateral and lower edge of the bone was continued a membraniform ligament, which, together with some thinner fibrous bands from its upper border where the tendo Achillis joined it, loosely united this sesamoid bone, like a capsular ligament, to the lower ends of the tibia and fibula. The interior of this sac, as well as the bony surfaces which it enclosed, were smooth, like the interior of a bursa, but were not lined by epithelial particles;

they were moistened, however, with glairy synovial fluid.

Mr. Curling observes that, whatever its functions, the formation of this bone must be attributed to pure accident; that in dissecting the tendo Achillis from the tuberosity of the calcis during the operation of 1852, he doubtless raised with it a portion of periosteum, which afterwards became a transplanted centre of ossification. Mr. Curling may be right in this conjecture, but might he not equally, in the operation of 1852, have separated the tubercular epiphysis of the os calcis from that bone, have left it attached to the posterior flap, and thus have unwittingly, in a measure, anticipated Pirogoff's operation? The thick skin and fat were identical with those of the natural heel. The length of the tibia measured thirteen inches and a quarter from the interarticular spine to the centre of its lower extremity.

OPERATIONS BY BRITISH SURGEONS.

SURGEONS.	Date.	Disease.	Sex.	Age	Life	Results. Use of Limb.
Gore, Bath	1847	Caries	F.	10	..	Good
,, ,, ...	1856	,, ...	F.	38	..	,,
Humphry, Cambridge	1847	Trau. gangrene	M.	25	..	Amputated
,, ,,	1859	Caries	M.	35	..	,,
J. C. Lansdown, Bristol	1847	,, ...	M.	22	..	Good
Wilkinson, Hartlepool	1848	,, ...	M.	16	..	,,
Critchett	1848	,, ...	F.	43	..	,,
,, ...	1849	,, ...	F.	17	..	,,
Busk	1857	5 cases	..	..	..	4 good, 1 amp
Sir W. Fergusson ..	1850	,, ...	M.	25	..	
,, ..	1850	,, ...	M.	21	..	Good
,, ..	1850	,, ...	F.	11	..	,,
,, ..	1850	,, ...	M.	36	D.	
,, ..	1852	,, ...	M.	20	..	Good
,, ..	1854	,, ...	..	..	..	Amputated
,, ..	1859	,, ...	M.	25	..	
S. Hey, Leeds	1850	Railw. accident	M.	..	D.	
Magrath, Teignmouth	1850	4 cases	..	..	..	Good
Amphlett, Birmingham	1851	.. .. ..	F.	24	..	,,
Crompton, Birmingham	1851	Caries	F.	24	..	,,
Wakley	1851	,, ...	M.	9	..	,,
Cam, Hereford	1852	Frozen	M.	..	..	,,
Curling	1852	Accident ..	M.	7	..	
,, ...	1856	Caries	..	..	..	Good
,, ...	1858	,, ...	..	20	..	,,
,, ...	1858	,, ...	..	14	..	,,
,, ...	1861	,, ...	..	28	..	,,
,, ...	1861	,, ...	..	28	..	,,
,, ...	1863	,, ...	..	..	..	,,
,, ...	1864	,, ...	..	14	D.	Pyæmia
,, ...	1866	,, ...	..	46	D.	Pyæmia
,, ...	1866	,, ...	..	14	..	Good
Field, Brighton	1852	,, ...	M.	..	..	,,
Avery	1853	,, ...	M.	25	..	,,
,, ...	1854	,, ...	M.	..	..	,,
Monro, Moffatt	1853	Railw. accident	F.	..	..	,,
Hadwen, Lincoln ..	1853	4 cases	..	1 d	..	3 good
A. Johnson	1853	,, ...	F.	..	..	Good
Pemberton, Birmingham	1853	Caries	F.	29	..	,,
,, ,,	1855	Hypertrophy	F.	1	..	,,
,, ,,	1855	Caries	F.	18	..	,,
,, ,,	1855	Railw. accident	M.	19	..	,,
,, ,,	..	Caries	M.	12	..	,,
,, ,,	..	,, ...	F.	33	..	,,
,, ,,	..	,, ...	M.	26	..	,,
,, ,,	..	,, ...	M.	13	..	,,
,, ,,	..	Accident ..	M.	27	D.	
,, ,,	..	Caries	F.	18	..	Good
,, ,,	..	,, ...	M.	39	..	,,
,, ,,	..	,, ...	M.	14	..	,,
,, ,,	..	,, ...	M.	24	..	,,
Edwards, Denbigh ..	1854	,, ...	M.	47	..	Amputated
,, ,, ..	1861	,, ...	M.	60	..	Good

SURGEONS.	Date.	Disease.	Sex.	Age.	Life	Results. Use of Limb.
H. Lee	1854	..	M.	..	..	Good
Wilmot, Dublin	1854	Caries	M.	28	..	,,
Wordsworth	1854	Accident	F.	..	..	,,
,,	1856	,,	M.	..	..	,,
Gay	1854	Caries	M.	52	D.	12 months
,,	1852	,,	F.	15	..	Good
Barber, Sheffield	1855	,,	M.	14	..	,,
,, ,,	1861	,,	..	..	..	,,
Adams	1856	,,	M.	..	..	,,
Cadge, Norwich	1856	4 cases	..	..	..	,,
Hamilton, Dublin	1856	Necrosis	M.	26	..	,,
Humphreys, Shrwsbury.	1856	..	..	..	..	,,
,, ,,	1856	..	..	..	..	,,
,, ,,	1856	..	..	..	..	,,
,, ,,	1863	..	..	..	..	,,
,, ,,	1863	..	M.	55	..	,,
,, ,,	1864	Accident	..	..	D.	From other Injuries.
Livy, Bolton	1856	..	M.	31	..	Amputat. 2 yrs.
H. Thompson	1856	6 cases	..	..	1 d	5 good
Barber, Sheffield	1857	Caries	M.	26	..	Good
Bickersteth, Liverpool	1857	,,	F.	13	..	,,
Crockett, Dundee	1857	,,	F.	20	..	,,
,, ,,	1857	,,	M.	40	D.	
Erichsen	1857	,,	F.	25	..	
J. Hamilton, Dublin	1857	,,	M.	..	..	Good
Quain	1857	,,	M.	21	..	,,
,,	..	,,	M.	20	..	,,
Rayner, Stockport	1857	,,	M.	..	..	
Rayner, Glasgow	1857	Accident	F.	9	..	Good
,, ,,	1857	,,	M.	18	..	
,, ,,	1857	Caries	F.	21	..	Good
O'Ferrall, Dublin	1857	,,	M.	..	..	,,
H. Coote	1858	,,	F.	25	..	
Cusack, Dublin	1858	,,	M.	19	..	Good
Gant	1858	,,	F.	64	..	,,
Marsden	1858	,,	F.	64	..	,,
Marshall	1858	,,	F.	34	..	,,
Nesbitt, Wolverhampton	1858	,,	M.	34	..	,,
,, ,,	1860	Accident	M.	..	..	,,
,, ,,	1864	,,	M.	..	..	,,
,, ,,	1864	Caries	M.	56	..	
Butcher, Dublin	1859	5 cases	..	..	..	1 good, 4 unsuccessful.
King, Hull	1859	,,	M.	28	..	Good.
,, ,,	1859	,,	F.	19	..	Good. 2 months.
Adams	1859	,,	M.	..	..	Good.
Macaulay, Leicester	1859	,,	F.	13	..	,,
,, ,,	1859	Accident	M.	11	..	,,
Paget, Leicester	1859	Caries	M.	27	..	,,
Paget, Glasgow	1859	,,	F.	17	..	,,
Wright, Nottingham	1859	,,	M.	56	..	Amp. 4 months.
Wright, Newcastle	1859	Comp. fracture	M.	30	D.	Pyæmia.
Benfield, Leicester	1860	,,	M.	17	..	Good.

SURGEONS.	Date.	Disease.	Sex.	Age.	Life	Results. Use of Limb.
Benfield, Leicester	1861	Comp. fracture	F.	..	..	Good.
" "	1861	"	M.	42	..	Amputated.
" "	1865	"	M.	11	..	Good.
Delagarde, Exeter	1860	Caries	M.	35	..	"
" "	..	..	..	..	..	"
Norman, Southsea	1860	Caries	M.	23	..	"
Tatum	1860	Accident	M.	11	..	"
"	1863	"	M.	38	..	Amputated.
Clark, Le Gros	1861	"	M.	14	..	Good.
"	1865	Caries	M.	16	..	"
F. Jordan, Birmingham	1861	"	M.	9	..	"
" "	1863	"	M.	28	..	"
" "	1863	"	F.	13	D.	Phthisis.
" "	1864	"	M.	10	..	Good.
" "	1864	"	M.	..	..	"
" "	1865	"	M.	11	..	"
J. C. Lansdown, Bristol	1861	"	M.	40	..	"
" "	1862	"	M.	17	..	Amputated.
" "	1863	"	F.	16	..	Good, 6 months.
" "	1863	"	M.	30	..	Good.
" "	1865	"	M.	40	..	"
Morton	1861	"	M.	..	..	"
Folker, Hanley	1862	Accident	M.	..	..	"
Holmes	1862	Caries	F.	4	..	"
"	1862	"	M.	8	..	"
"	1863	"	M.	25	..	"
"	1863	"	F.	28	..	"
"	1864	"	F.	2	..	"
"	1866	"	F.	4	..	"
H. Smith	1862	"	M.	8	..	"
"	1865	"	M.	21	..	"
Walker, Peterborough	1862	Accident	M.	..	..	"
" "	1864	"	M.	..	..	"
Edwards, Peterborough	1863	Acute Inflam.	M.	12	..	"
Jackson, Darlington	1863	..	M.	29	..	"
" "	1864	..	M.	50	..	"
" "	1864	..	M.	21	..	"
" "	1865	..	M.	15	..	"
Partridge	1863	..	M.	..	..	"
Solly	1863	Caries	M.	26	..	"
"	..	"	M.	24	..	"
"	1865	"	F.	25	..	"
Symes, Dublin	1863	"	M.	18	..	"
" "	1863	..	M.	19	..	"
Walsh, Worcester	1863	Malignant	M.	47	D.	Pyæmia.
Wilmot, Dublin	1863	3 cases	..	..	..	Good.
Budd, Worcester	1864	Caries	..	..	..	"
Hillman, Kidderminster	1864	Accident	M.	12	..	"
Carr, Jackson	1864	Caries	F.	11	D.	Tblr. Meningitis
Rowe, Margate	1864	"	M.	13	..	Good.
" "	1864	"	M.	8	..	Amputated.
Simpson, Lincoln	1864	"	F.	25	D.	Phthisis.
Bird, Stockport	1865	Cmp. fracture	M.	14	..	Good.
Little	1865	Accident	F.	1½	..	"

SURGEONS.	Date.	Disease.	Sex.	Age.	Life	Results. Use of Limb.
Meade, Bradford	1865	Accident ..	..	..	..	Amputated.
Bellingham	..	.. .. ..	..	..	..	Good.
Hunter, Margate	..	8 cases.. ..	..	..	..	”
Lowdell, Brighton ..	..	.. .. ..	..	..	D.	
” ” ..	..	.. .. ..	..	..	..	Good.
Lyon, Glasgow	..	Caries	..	..	..	”
Page, Cambridge	..	.. .. ..	..	..	..	”
Smith, Leeds	..	.. .. ..	..	..	..	
Spence, Edinburgh ..	..	.. .. ..	..	..	..	Good.
Tudor, Dorchester ..	..	.. .. ..	..	..	..	”
Wright, Cheltenham ..	..	.. .. ..	..	..	..	”
Jackson	1864	Caries	M.	..	..	”
Sampson, Southampton	1865	Accident ..	M.	15	..	”
Simon	1865	Caries	M.	29	..	”
Wilkes, Salisbury	1867	Perf. Ulcer..	M.	39	..	”
Savory	1866	Caries	M.	59	..	Not stated.

OPERATIONS BY FOREIGN SURGEONS.

SURGEONS.	Date.	Disease.	Sex.	Age	Life	Result. Use of Limb.
Baudens	1839	3 cases	..	..	1 d.	2 good.
Blandin	..	..	..	..	..	
Brasdor	..	..	..	..	..	
Chelius, junior	..	Caries	..	..	..	Good.
De Lambaille	..	..	..	..	..	
Duncan	..	..	..	..	..	
Fab. de Hildanus	..	..	..	..	..	
Günther	..	Caries	..	..	D.	
Heyfelder	..	..	..	..	..	
Jobert	..	..	..	..	..	
Metz	..	..	..	..	..	
Odevoine	1858	Caries	F.	60	..	Good.
Pauli	..	..	..	..	..	
Pirogoff	..	..	..	..	..	
Pitha	..	..	..	..	..	
Robert	..	Caries	..	..	..	Good.
Rognetta	..	..	..	..	..	
Rossi	..	..	..	..	..	
Roux	1846	Caries	..	..	..	Good.
Sabatier	..	..	..	..	..	
Sédillier	..	..	..	..	..	
Sédillot	..	Caries	..	..	..	Good.
Stromeyer	1856	Gunshot	..	..	D.	Pyæmia.
,,	1856	,,	M.	..	..	Good.
Textor, senior	..	..	..	..	..	
Textor, junior	..	7 cases, 1 acc. 6 disease	.. ..	.. ..	D. 1 l.	5 good.
Velpeau	..	..	..	..	..	
Wertzer	..	..	..	..	..	
Zeis	..	..	..	..	..	

I have, as before stated, the particulars of 219 cases of Syme's operation, exclusive of those performed by Syme himself.

Of these 144 were performed for caries.
" 22 " " accident.
" 2 " " gunshot wounds.
" 1 " " hypertrophy.
" 1 " " malignant disease.
" 1 " " necrosis.
" 1 " " frost-bite.
" 1 " " traumatic gangrene.
" 1 " " acute inflammation.
" 45 diseases not stated.

Results.

13 suffered secondary amputation.
17 died.
183 recovered, and could walk well.
6, results not stated.

Of the 13 amputations—in 8, the period between Syme's operation and secondary amputation is not stated; in 2, two months; in 1, four months, and in 2, two years intervened between the two operations. Nine of the amputations were performed upon patients who had undergone primarily Syme's operation for caries; and of these one was a confirmed drunkard, one had been primarily operated upon for traumatic gangrene, one two years previously for accident, and in the remaining two the disease is not stated.

Of the 17 fatal cases, 4 died of pyæmia; of these, one had been operated upon for malignant disease, one for accident, one for gunshot wound, and in the fourth the primary disease is not stated. In 5 the operations had been performed for accident, one of the patients dying of pyæmia, as already stated. In 10 the operations had been performed for caries; of these, one died twelve months after the operation, 3 died of phthisis, and one died of exhaustion caused by diarrhœa.

These are the results of this operation performed in civil practice in this country; and they must be regarded as most favourable, especially when we consider that it has been restricted neither by class, sex, nor age. Of the 219 cases, the ages have ranged from one to sixty-four years (although we read that Mr. Syme operated upon an infant aged five months), the youngest having been operated upon by Mr. Pemberton, of Birmingham; whilst Mr. Marsden and Mr. Gant, of the Royal Free Hospital, and Mr. Nesbitt, of Wolverhampton, can claim the credit of having performed this operation successfully on the three oldest patients hitherto submitted to the procedure.

In military practice it would seem to be equally successful. Staff Surgeon Gordon, of the 95th Regiment, which suffered so severely at the battle of the Alma, thus writes to Mr. Syme:—"I have much pleasure in stating that several cases of amputation of the foot, as first proposed and practised by you, were performed after the battle of the Alma, and the results were most favourable. Those cases which came under my observation healed more rapidly than when the operation was performed at the lower third of the leg, and at the same time a much more useful stump was the result."

We read also that, during the first two years of the American war, operations were performed upon 187,470 wounded soldiers. Of these, 9,705 were cases of amputation. The following table, taken from the Surgeon-General's reports, shows the number belonging to each region, and the regular increase in the rate of mortality as the trunk is approached:—

—	Re-covered.	Died.	Gross number of cases.	Per centage of Deaths.
Fingers and parts of hand	1778	28	1807	1·60
Wrist	34	2	36	5·55
Elbow	19	0	19	—
Forearm	500	99	599	16·52
Arm	1535	414	1949	21·24
Shoulder-joint	144	93	237	39·24
Toes	784	6	790	75
Partial of foot	108	11	119	9·24
Ankle-joint (Syme)	58	9	67	13·43
Leg	1737	611	2348	26·02
Knee-joint	52	64	116	55·17
Thigh	568	1029	1597	64·43
Hip-joint	3	18	21	85·71

In India the operation has not proved so successful. My friend and old pupil, Professor Fayrer, senior surgeon to the hospital at Calcutta, thus writes me:—"You will see the mortality in my foot operations is very *great*. Gangrene and pyæmia are most destructive, and most of the cases were *ab initio* unfavourable. We try all we can to get improvements made, and we have personally expressed our opinion that the present hospital ought to be given up, but it is hard to move the authorities in these matters. Osteo myelitis is the great cause of death with us, and pyæmia its natural consequence."

The following shows the results of twelve cases of Syme's operation performed by Dr. Fayrer in the hospital:—

Hindoo groom	25	May 21, 1859	cured Nov. 4	Caries
,,	38	Feb. 25, 1860	,, —	Dry gangrene
,,	38	May 16	died June 8	Pyæmia
Gangrenous ulcer	25	October	,, Nov. 3	,,
Epithetical cancer	40	Oct. 30	,, Nov. 28	,,
Caries	40	Nov. 1	,, Nov. 30	,,
,,	39	Feb. 15	,, April 30	,,
,,	54	March 1	,, March 4	Gangrene
,,	45	May 29	removed by friends June 8	
,,	28	June 8	cured August 24	
,,	30	Feb. 27	died March 17	Pyæmia
,,	34	May 28	,, June 11,	Stump sloughed

So that of these 12 cases

3 were cured.
The result of 1 is not known.
6 died from pyæmia.
1 ,, gangrene.
1 ,, sloughing stump.

LECTURE IV.

MODIFICATIONS OF SYME'S AMPUTATION.

MR. PRESIDENT AND GENTLEMEN,—

Various modifications of Syme's operation have been proposed, some of which are so beside the mark that it will be unnecessary to notice them here.

We have already considered the dorsal flap of Baudens and the plantar flap of Syme. To these M. Roux adds his lateral flaps, as tending to obviate the objections alleged against the latter proceeding. He asserts that his method presents the double advantage of placing the cicatrix in front, above, and to the external side of the stump, thus avoiding the danger of rubbing and irritation, whilst it affords greater facility of execution and certainty of results.

Blandin and Handyside also advocate lateral flaps, alleging that they prevent bruising and twisting of the soft parts in removing the os calcis; but, as Mr. South justly observes, there is no necessity to bruise or twist the soft parts, whilst the side flaps do away with one of the principal advantages of Syme's operation, the preservation of the dense structures especially designed for supporting the weight of the body.

Messrs. Spence and Goodsir commence by the usual dorsal incision, and then carry the knife deeply across the plantar surface of the heel, from the internal to the external malleolus, where the incisions commenced. Having thus formed the flaps, they cut through the external lateral ligament, and keeping the knife close to the bone, divide the internal lateral ligament and soft parts on the inner side of the foot, which is next turned forwards. The tendo Achillis is then cut through, and the bone easily turned out from the plantar flap. The benefits they assign are greater facility and rapidity, and less twisting and manipulation of the plantar flap.

The late Dr. K. J. Mackenzie, of the Edinburgh Infirmary, advised: "The point of the knife to be entered at the mesial line of posterior aspect of ankle on the level of the articulation, and carried obliquely downwards across the tendo Achillis towards the outer border of the plantar surface of the feet, along which it is continued in a semilunar direction. The incision then curved across the sole of the foot, terminated on the inner side of the tendon of the tibialis anticus, an inch in front of the inner malleolus. A second incision is carried across the outer side of the ankle in a semilunar direction, between the extremities of the first incision, the convexity directed downwards, and half-an-inch below the external malleolus. The flap is next dissected up, the knife being kept close to the bone to preserve the whole thickness of the soft parts; and by holding the base of the flap between the finger and thumb as it is detached from the bones, all risk of wounding the artery is avoided. The foot is then severed at the articulation, and a thin slice with the malleoli removed by a saw, as in Syme's operation."

M. Sédillot advocates a similar proceeding, which is said to be superior to that of Syme, in cases wherein the integuments on the outside of the foot are unsound; in old people, whose arteries are not well suited to bear with impunity the stretching which occasionally occurs in separating the integuments from the heel-process; and lastly, from its being more easily performed.

Mr. Quain, on the other hand, maintains the plantar flap, but after making the cut across the sole of the foot from one malleolus to another, he carries a second, at right angles with it, on the outside of the foot back to the heel, between the point of the outer malleolus and the margin of the foot. He cuts the inferior flap short, and bevels off the edges of both flaps, so that skin should meet skin. He first performed this operation in the year 1851, and claims as its advantages greater facility of performance, and diminished probability of collections of matter and occurrence of gangrene.

But of all the modifications, that which has attracted the greatest attention and taken the firmest hold upon the profession, is the one introduced by Pirogoff during the Crimean war, and which is now universally recognised as "Pirogoff's operation." This consists in sawing through the os calcis from above downwards in front of the heel-process, and leaving the latter undisturbed in the soft parts constituting the posterior flap, instead of dissecting out the entire os calcis, as in Syme's method. It appears to have been first performed in this country by Mr. Ure, whose patient, however, died soon after of disease of the brain. The first well-authenticated cases are those operated upon by Mr. Busk at the Dreadnought, in the year 1857. The success which attended these operations, as well as those performed by Pirrie in the same year, by Sir William Fergusson, Messrs. Croft, Marsh (of Northampton), M'Ghee, Partridge, Tudor, and Williamson, in the year 1858, so established this proceeding at the time, that it has at length become not only a generally recognised operation, but is considered by some of our highest authorities as equal, if not superior, to that originated by Mr. Syme, and therefore worthy of universal adoption. I propose to show to what extent this view is correct or otherwise.

Pirogoff's method, as given by Mr. Spencer Wells, is as follows:—"He commences his incision close to the front of the external malleolus, carries it vertically downwards to the sole of the foot, then transversely across the sole, and lastly obliquely upwards to the inner malleolus, where he terminates it a couple of lines anterior to that process, the inner extremity being carried some lines more forward than the outer to avoid wounding the posterior tibial artery prior to its division. Thus, all the soft parts are divided at once to the os calcis. He then connects the outer and inner extremity of the first by a second semilunar incision, the convexity of which looks forwards, and cutting through the soft parts down to the bones, he proceeds to open the joint from the front, cuts through the lateral ligaments, and thus exarticulates the astragalus. He then places a small amputation saw upon the os calcis, behind the astragalus, exactly upon the sustentaculum tali, and cuts through the os calcis, so that the saw passes into the first incision through the soft parts. Lastly, he separates the short anterior flap from the two malleoli, and saws through both of them close to their bases. He then turns the posterior flap forwards, and bringing the cut surface of the os calcis in apposition with the articular surface of the tibia, he unites the two flaps by sutures, always leaving the angles of the wound open to admit of free discharge. Should the articular surface of the tibia be diseased, it is sometimes necessary to saw off a thin slice from it with the malleoli."

It would appear from this description, that when the articular surface of the tibia is healthy, Pirogoff brings the cut surface of the os calcis in contact with the cartilage investing that articular surface. At all events, it is doubtful whether he does or does not. I regret that I cannot clear this point up. I wrote to M. Pirogoff expressly upon the subject, but I have not received a reply.

Be this as it may, he claims the following advantages for his operation:—

1st. The tendo Achillis is not divided, and so we avoid all the disadvantages connected with its injury.

2nd. It also follows that the base of the posterior flap is not thinner than its apex, whilst the skin on the base of the flap remains united with the fibrous sheath of the tendo Achillis.

3rd. The posterior flap is not cup-like as in Syme's method, and its form, therefore, is less favourable to a collection of pus.

4th. The leg, after the operation, appears to be an inch and a half (sometimes more) longer than in the three other operations, Syme's, Baudens', and Roux's, because the remnant of the os calcis left in the flap, as it unites with the inferior extremities of the tibia and fibula, lengthens them by an inch and a half.

5th. It serves the patient as a point of support.

Up to April 1853, he had performed the operation three times upon patients aged respectively 12, 13, and 19 years. All recovered well, and two walked without crutch or stick, and without limping. He adds a remark well worthy of notice, and one also which confirms what I have already advanced in my second lecture:—" That notwithstanding the suppuration and the considerable gravitation of pus in the third case; notwithstanding the softness and fatty degeneration of the os calcis, which could be cut with a knife, still the remnant of the os calcis united firmly with the tibia. In the second case (he adds) he found pus in the joint during the operation, the cartilage inflamed and decayed, the ends of the bones softened, and a fatty degeneration; yet the result was most successful." As regards this point, Mr. Croft, in his excellent paper "On the Experience of the Surgeons of the Dreadnought," in this operation remarks: "I may observe that, although the os calcis may be diseased at and about the articulating surfaces in instances of scrofulous disease of joints ot tarsus, it is rarely that the posterior part is rendered too unhealthy to be made use of in the formation of the stump."

Mr. Busk recommends that the os calcis should be cut obliquely from behind forwards, instead of vertically. And for this purpose he inserts the saw well behind the calcaneo-astragaloid articulation, and brings it out at the calcaneo-cuboidal articulation. He says that the advantages of his section of the bone are, that a more extensive surface of the bone is brought in contact with the tibia; that the remaining portion of the os calcis does not require to be rotated so much on its axis as is necessary in Pirogoff's operation; that the tendo Achillis is not so much stretched; and that the portion of the heel naturally in contact with the ground still remains the basis of support.

Watson, of Glasgow, recommends the incision to be made across the sole of the foot from one malleolus to the other, down to the os calcis. He then cuts through the os calcis obliquely to avoid the malleoli. Then resuming his knife, he places it between the cut surfaces of bone, and cuts the posterior flap upwards and backwards until he gets fairly behind the ankle. An assistant then turning this flap upwards, and at the same time gently drawing up the skin of the front of the ankle, Dr. Watson carries his knife round the front of the joint, divides the tendons, and then with a saw completes the operation by cutting through the tibia and fibula downwards and backwards.

The originality of this proceeding has been denied by Dr. Martin, of Warrington, who writes that he saw Dr. Pirrie perform the same operation more than two years before; and indeed at page 754 of Pirrie's work "On the Practice of Surgery," we find, quoad Syme's operation—"Instead of disarticulating the foot, and then sawing off the malleolar processes and thin piece of tibia, I have, after making clearance for the saw by sending the knife round the bones, sawn off the malleoli, &c., without effecting disarticulation. This shortens the proceedings; and whenever I have performed this operation, nothing could have been more satisfactory than the results."

Staff Surgeon Williamson, Fort Pitt, recommends that the lower ends of the tibia and fibula should be sawn off obliquely from before upwards and backwards. This facilitates the adaptation of the os calcis to the ends of the bones greatly, and is certainly well worthy of consideration. He relates a case operated upon by him on December 24, 1858, wherein the os calcis fitted admirably, the wound healed readily, and a very solid stump resulted.

Mr. Curling adopted this method on January 5th, 1859; but the result of his case is not given.

Sir W. Fergusson also cuts through the os calcis from below upwards. He begins his incision at the internal malleolus, carrying it across the sole of the foot to the external malleolus. He then saws the os calcis through from below upwards, after which he makes the incision on the dorsum of the foot, and separates it from the leg. In one case he found the astragalus firmly anchylosed to the tibia. He therefore cut through the tibia and fibula, and removed them altogether.

In treating of the advantages and disadvantages of Syme's operation, I considered that operation, as you may remember, upon its own merits, or at all events with reference to amputations of the leg only. I drew the comparison between it and Pirogoff's modification, as such comparison could only be made satisfactorily when we had the objects and modus operandi of both methods before us. As we are now in possession of these facts, I will proceed to consider the advantages and disadvantages of Pirogoff's operation as compared with those of Syme's, not only with reference to civil, but also as regards military surgery.

Mr. Busk, who maintains Syme's originality in demonstrating that a useful flap could be made from the natural cushion of the heel, and who entertains the highest possible sense of the great merits of the operation, writes, that since the introduction of Pirogoff's proceeding he has never had occasion to adopt it.

According to Mr. Busk the advantages of Pirogoff's operation are :—greater facility and rapidity of performance; less disturbance of parts to form the cushion; a solid instead of a hollow flap; and a greater length of stump by an inch and a half.

According to Mr. Erichsen, they consist in the stump being longer, and better adapted for pressure; in the readiness of the union between the two applied osseous surfaces; and in the less likelihood of the supply of blood to the posterior flap being interrupted, as its vascular communications are not much disturbed, and the plantar arteries can always be cut long.

I do not see the force of the latter proposition, as there is nothing in Syme's method to prevent the plantar arteries being cut as long as the posterior flap, which is all that can be done in Pirogoff's operation.

Sir James Paget informs me that he has performed Pirogoff's amputation several times with a completely satisfactory result, and that he thinks more highly of it, than of any other operation of the kind.

Mr. Partridge considers that there cannot be a doubt of the superiority of Pirogoff's method over that of Syme.

Mr. Henry Smith, though so successful in his performance of Syme's operation, says it is his intention to adopt Pirogoff's for the future, as of its superiority no one who has seen a few cases can doubt.

Mr. Wood's experience of Syme's and Pirogoff's operation has been favourable in both, but he thinks the stump of the latter operation has been generally better.

Mr. Cadge, of Norwich, has the highest opinion of both. He does not think there is much advantage in one over the other, as the resulting stump in both is, to his mind, the best possible.

The objections urged by Mr. Syme against Pirogoff's operation are—first, that the os calcis is a bone predisposed to caries, and it is, therefore, undesirable to leave any part of it.

Surgeon Cusack and Surgeon Little both operated *à la* Pirogoff. In both cases disease returned in the portion of the os calcis left behind, and necessitated the removal of the limb. The operation is certainly open to this objection, and, undoubtedly, cases similar to those here quoted have occurred.

For instance, in a case operated upon by Sir W. Fergusson, he four months afterwards gouged away dead bone, and four months after that there were still dead bone and fistula.

In another case operated upon by the same distinguished surgeon, three months after the operation fistulous openings remained, though the patient could bear pressure.

Mr. Simon, in one of his cases, had to remove secondarily two pieces of dead bone, and at the end of 426 days union was still infirm.

In a second case he had to remove a portion of the os calcis. Obstinate sinuses remained, and the patient was not cured for 483 days.

We should not forget, however, what has been stated by Piragoff—that, notwithstanding the os calcis has been so soft that he could cut it with a knife, still the remnant of the os calcis united firmly with the tibia, and the patient was able to walk freely without the aid either of crutch or stick.

Of fifty-eight operations performed by British surgeons, I find that, including the two quoted by Syme, five were succeeded by amputation of the leg, of which one was performed a few days after the original operation for secondary hæmorrhage.

Mr. Butcher, of Dublin, and Mr. Walsh, of Worcester, each relate a case in which they commenced their proceedings for Pirogoff's operation, but in consequence of the condition of the calcis found it necessary to convert it into Syme's operation.

Mr. Lowe, of Lynn, in 1860 commenced Pirogoff's operation on a boy aged 12, for caries of the tarsal bones. He found the os calcis diseased, and gouged it away, merely leaving the periosteum. Unhealthy ulceration, however, attacked the stump, and he was subsequently obliged to amputate the limb. Whether these gentlemen were unduly alarmed at the condition of the os calcis or not, these examples do not appear to me to detract from the value of Pirogoff's operation in proper cases. They add, however, greatly to that of Syme's, since they show the applicability of the latter when the former cannot be trusted.

Mr. Syme's second objection, that the operation is greatly complicated by the employment of chain saws, &c., is negatived by the fact that chain saws are neither necessary, nor are they in the present day employed in its performance.

His third objection is that union between the two osseous surfaces is not likely to take place easily.

Mr. Busk has shown that this objection is groundless. In Mr. Tudor's last case the bones had united on the twelfth day. In Mr. Busk's first case, the patient stood on the fourteenth day. Mr. Croft says, in two of the Dreadnought cases, the os calcis was firmly united to the tibia in three weeks; whilst the recovery of Mr. Partridge's two cases is stated to have been very rapid.

Mr. Syme's last and principal objection is, that the integuments of the heel, which should form a cushion for the patient to rest upon, are necessarily carried forward, and the end of the stump is covered by skin, which is not designed for sustaining the weight of the body.

If this objection were valid, it would at once reduce the operation to the level of Baudens' proceedings; but Mr. Busk has proved that when the os calcis is cut as he proposes, that portion of the heel naturally in contact with the ground still remains the basis of support.

The great disadvantage attending this operation is undoubtedly the collection of matter in the sheaths of the tendons so frequently observed after its adoption. Pirogoff attributes this to the tendons being cut too short, and retracting either within or beyond their sheaths. He adds, that he fears nothing so much, and strongly advises that the tendons be fixed before and during the operation, and that the limb be maintained in one position, as the best means of avoiding this complication. Mr. Busk, on the other hand, reports that suppuration occurred in some, if not all of his cases, notwithstanding the methodical application of compresses, as suggested by Pirogoff; whilst, as we shall see further on, Messrs. Marsh and Ashdown, of Northampton, purposely cut the tendons as short as possible, and both their cases recovered without any suppuration at all. Mr. Tudor, of Dorchester, one of the first to perform this operation in England, says: "It appears to me that Syme's is in many cases to be preferred, because we know that when once one tarsal bone is affected the others very soon become so, and this from constitutional causes; and though at the time of operation the os calcis may not be diseased, still from the extra pressure upon it, and from the abnormal position in which it is placed, I should fear risk was incurred by exciting that disease in this now *more* important bone which we may suppose originally existed. The comparative length of the stump I consider of little moment, because the difference is so trifling. Again, I consider the amount of skill required in the performance of Pirogoff's operation to be greater than in Syme's," &c.

Sir Henry Thompson objects, that in consequence of the increased length of stump, it is more difficult to adjust an artificial foot. Neither can he imagine that the retaining a portion of bone in the lower flap can contribute in any way to a rapid convalescence.

I have collected the particulars of 58 cases of Pirogoff's operation performed by British surgeons. I have not included those reported by Pirogoff; for, although this eminent surgeon reckons nearly 100 cases performed in Russia, he does not give any available statistics to enable us to arrive at a satisfactory or definite conclusion. Of the 58 cases, suppuration in the course of the sheaths of the tendons, and in the neighbourhood of the stump, is specially noticed in 11; whilst sloughing of the stump occurred only in 1 case, and in that it is attributed to disease of the blood-vessels. Five cases out of the 58 terminated fatally, or about $9\frac{9}{10}$ per cent.; of these 1 died of pyæmia, 1 from kidney disease, and 3 after accidents—2 on the same evening, and 1 in four days. Five suffered secondary amputation; of these, the original operation in 4 had been performed for caries, and in 1 for accident, the secondary operation being required for hæmorrhage. Forty-three terminated favourably, affording the patients good and useful stumps. Of these, 25 were performed for caries, 2 for frost bite, and 18 for accidents; the result of 3 is not known. With regard to the period of cure, I am enabled to give a somewhat higher percentage of results than I could of Syme's; for whereas, of 219 cases of the latter, I could only give the result of 40 (rather less than one-fifth), of 58 cases of Pirogoff's, I am enabled to give the result of 15 (a fraction above one-fourth).

Of the 15 cases 8 had been operated upon for caries, and 7 for accident.

Of the 8 former,

1	recovered with firm stump in ..	7	weeks.
1	” ” ..	8	”
2	” ” ..	12	”
1	had firm stump, but also fistulous openings	12	”
1	recovered with firm stump ..	40	”
1	” ” ..	69	”
1	had infirm stump	61	”

Of the 7 latter,

1	recovered	with firm	stump in	..	6	weeks.
1	,,	,,	,,	..	7	,,
1	,,	,,	,,	..	8	,,
1	,,	,,	,,	..	10	,,
2	,,	,,	,,	..	12	,,
1	,,	,,	,,	..	24	,,

So that whilst in the former class the period of recovery varied from 7 to 69 weeks, in the latter it varied from 6 to 24 weeks.

Croft reports that in 3 cases the remnant of the os calcis united to the tibia in 3 weeks, in 1 in 12 days.

Mr. Busk reports that one of his patients stood on the 14th day. He saw another 7 months after operation; he had in the mean time been a voyage, and worked as a seaman.

Mr. Simpson, of Lincoln, states that a patient upon whom he performed this operation can walk fourteen miles a day without fatigue.

Mr. Partridge also reports the recovery of two of his cases as being very rapid.

Mr. H. W. Budd, of Worcester, has most kindly furnished me with the particulars of the two following cases:—

J. C., aged 26, admitted into the Worcester Infirmary on February 24th, 1866. Foot smashed by a railway accident. The astragalus and os calcis, with the integuments of heel, uninjured. A wound extended from about two inches above and behind the internal malleolus, across the front of the ankle joint, to a corresponding point above the malleolus externus. The integuments of the upper margin of the wound were separated upwards for an inch. They were cold, and there was extravasated blood here and there. Although sloughing was apprehended, Pirogoff's operation was decided upon. The case went on favourably. The patient recovered with an excellent stump, half an inch shorter than the sound one.

March 31st: Union of bone perfectly firm. He has been walking about for some weeks.

J. L., aged 18, admitted under Mr. Budd's care, February 26th, 1866, with disease of ankle-joint and tarsus, of twelve months' duration. There were two sinuses, one on each malleolus, communicating with dead bone. Great pain on pressing astragalus against tibia; considerable swelling of foot.

March 26th: Pirogoff's operation performed; all the bones of the ankle were diseased; the os calcis was very soft, and the soft parts were infiltrated with gelatinous or scrofulous substance. This infiltration and the state of the os calcis compelled Mr. Budd to remove more of this bone as well as of the tibia. The case did well, without any bad symptom. Discharged cured May 20th.

Mr. Ashdown, of Northampton, has also favoured me with the two following cases, which go far to establish the value of Pirogoff's amputation:—

E. P., aged 29, married, a very delicate woman, four months advanced in pregnancy, admitted May 16, 1858. Three hours previously, a gun, charged with common-sized shot, fell from its support, and went off on the ground a few feet from her, the contents striking the sole of her left foot. There was copious hæmorrhage at the time. When admitted, after a journey of twelve miles, she was collapsed; pulse quick and feeble; countenance pale and anxious. When the bandages were removed there was considerable oozing of venous blood. The integuments and muscles of the sole of the foot, the heel excepted, were ploughed up from the bones; the metatarsal bones all more or less fractured and comminuted; the integuments generally livid and pulpy, and the great toe hanging loose from the rest of the foot.

The patient having rallied sufficiently in a few hours, Mr. Marsh removed the foot by Pirogoff's amputation. In so doing the posterior artery was divided above its bifurcation and ligatured, and Mr. Marsh, having made the tendons protrude as much as possible, cut them short off, and brought the parts together. For the first two days the patient was very feeble, feverish, and sick, the vomiting (of pregnancy apparently), which had been troublesome for above a month, being now constant. She ultimately, however, did well, and six weeks after the operation was out of doors, and in another week left the hospital.

She was in due course confined, and was ill for a long time after; but for many months past has walked upon the stump regularly, and without inconvenience.

E. B., aged 42, admitted under the care of Mr. Ashdown, February 24, 1860, having had her feet entangled in the machinery of a thrashing machine a few hours previously. Mr. Ashdown performed Pirogoff's amputation on the right foot. The wound healed by first intention, and the patient did well until the tenth day, when bilious vomiting came on, and lasted a week. She, however, ultimately did well.

I am indebted to my old friend and pupil, Mr. Folker, of Hanley, for the following:—

T. H., aged 21, had his foot severely crushed by an engine and tender running over it on November 8, 1865. Mr. Folker at once performed Pirogoff's amputation, removing about three-quarters of an inch of tibia and fibula. A small abscess formed, but speedily healed after being opened. In a month the patient was allowed to get up, and could bear some weight upon the stump. He left the Infirmary on 16th December, able to walk without pain, the bones being firmly united. He has since followed his former occupation of a coach trimmer, walking backwards and forwards to his work every day. He uses a stick, but can do very well without it.

I am also indebted to Mr. Henry Smith for the following very interesting case:—

An artillery man, aged 26, had extensive disease of the right ankle-joint, for which Mr. Smith performed Pirogoff's amputation on the 8th August, 1863. A remarkably rapid recovery took place, and in seven weeks the patient was well. Mr. Smith saw the man a year afterwards; the stump was well formed, not at all sensitive, and he could walk well by the aid of a simple bucket apparatus applied to the leg.

My colleague, Mr. Canton, also performed Pirogoff's amputation upon a young lady with excellent results.

Dr. George Buchanan, Glasgow, has likewise published a case in which he successfully performed Pirogoff's amputation upon a man whose foot had been crushed by machinery.

Mr. Shepherd, of Worcester, performed this operation upon a railway guard, 29th October, 1864, for compound fracture of the tarsal bones, the os calcis alone remaining uninjured.

Secondary hæmorrhage occurred, and rendered amputation of the leg necessary. The man ultimately recovered.

My own experience of the operation is certainly very favourable.

Out of Russia, Pirogoff's operation has not found much favour in the eyes of military surgeons; Stromeyer doubts its success, and the American surgeons are by no means enthusiastic in its praise. In the "Report of the Medical and Surgical History of the late Rebellion," published by the Surgeon-General of the American army, it is stated that the record of amputations at the ankle-joint is far from complete; and that in the terminated cases, Syme's method was employed in twenty-five, Roux's method in two, and Pirogoff's in nine cases; that several casts and photographs of well-rounded stumps obtained by the latter procedure are deposited in the Army Medical Museum. Still the operation appears to be regarded with little favour. The following abstract of a favourable case is given: Lieut. W. C. W—— was wounded April 1st, 1865, at the battle of "Five Forks," by a conoidal musket ball, which passed through his left ankle-joint. He was immediately carried to the hospital at City Point, and amputation at the ankle was performed on the same day by Surgeon St. Clair. The articular surfaces of the tibia and calcaneum were removed, and the cut surfaces brought in apposition. On April 16th the patient was removed to Armoury Square Hospital, at Washington. On admission he was in a feeble condition. An erysipelatous blush extended above the knee on the injured side, an abscess had formed in the lower part of the leg, and no union of the flap had taken place. With the employment of stimulants and nutritious diet, with emollient applications to the limb, there was gradual improvement until April 28th, when symptoms of pyæmic infection supervened. Rapidly recurring chills, an icteroid coloration of the skin and conjunctiva, anorexia, and a feeble pulse, suggested the gravest prognosis. Energetic treatment was adopted. One ounce of brandy was given every two hours with quinine; sesqui-chloride of iron and beef tea were freely administered. On May 6th the grave symptoms began to subside, and on June 26th he was pronounced well.

In the *American Quarterly Journal* for January, 1866, Professor Holloway, of Louisville, Kentucky, gives his experience of Pirogoff's operation in military surgery in reply to a paper which I read before the Medical Society of London in the year 1863, on the Comparative Merits of Pirogoff's, Syme's, and Chopart's Operations in Civil Surgery, confining himself exclusively to the notice of cases which came directly under his own observation: he adds, "These reports will show that Pirogoff's and Syme's have not generally proved favourable, although skilfully performed, and as a general rule well cared for afterwards. In Pirogoff's operation the non-union between the coaptated surfaces of the os calcis and tibia was one cause of failure; the retraction of the heel and corresponding depression of the anterior aspect of the stump, thereby throwing the cicatrix upon the sole, another cause. Inflammation of the sheaths of the tendons was not observed in most; in others where this complication did exist, it did not impress me as being so serious an interference as Mr. Hancock found it. In one case these abscesses along the sheaths of the tendons were secondary to caries and necrosis of the sawn extremities of the bones, which caries and necrosis terminated in complete disintegration of the os calcis and the spongy structure of the tarsal extremity of the tibia."

Case 1.—A soldier in good health, 24 years of age, submitted to Pirogoff's operation performed by Professor Eve, of Nashville, in the fall of 1863. Professor Holloway saw the case in the following January. The flaps had united, but a number of sinuses communicated with the coaptated surfaces of the os calcis and tibia, at the bottom of which denuded bone could be felt on introducing a probe. In addition to these, other sinuses, situated on the lateral aspects of the lower third of the leg, communicated with the sheaths of the tendons. These latter, from the statements of the patient, appeared subsequent to those leading to the carious bone. The integuments overlaying and adjacent to the diseased bone, presented a remarkably healthy appearance, so much so that the true condition of the stump did not transpire until a more thorough examination was made while the patient was under the influence of chloroform. Such was the complete disintegration of the os calcis and the end of the tibia, that amputation was performed in the month of February.

Case 2.—Corporal Holland, wounded at Chancellorsville, on May 3, 1863, submitted to Pirogoff's operation. Fourteen months afterwards Professor

Holloway found the stump healed, but the parts were still swollen and œdematous; patient unable to walk without crutches; heel drawn upwards, and cicatrix of flap thrown downwards and forwards, so that during locomotion it came in contact with the floor. No traces of the existence of inflammation of the sheaths of the tendons remained, and the bones seemed to be sound.

Case 3.—Private Clark, wounded near Spottsylvania, May 10, 1864, submitted to Pirogoff's operation. Seventy-one days afterwards the soldier was able to proceed to his home in Georgia, though the stump was not entirely healed, and considerable tumefaction of the stump and leg still existed. The heel was drawn up as in the above-named case, and the tender cicatrix constituted a part of the sole of the stump.

The Professor remembers three other cases. One in which a double amputation was performed on the field; Pirogoff's operation on one, and amputation of the other by Lenoir's method. The man died, but not before the flaps of the former had sloughed. In the other two cases the cicatrices were thrown forwards and downwards by the retraction of the heel. The parts had healed, but the condition of the stump was not favourable for easy and painless locomotion. Here, then, we have the opinion of Professor Holloway in six cases. One case suffered subsequent amputation, and died from sloughing of the flaps; and in all the remaining four, the cicatrices were thrown downwards and forwards by the retraction of the heels. It must be admitted that if this unfortunate result were of frequent occurrence, it would materially lessen, if not entirely destroy, the value of the operation. I have not, however, found it even alluded to by any other surgeon, although the probability of its occurrence appears to have been anticipated by Mr. Bryant, who, in 1860, divided the tendo Achillis of a patient at the time of operation. The patient walked in three months. The information given of the results of this operation performed during the late wars in the Crimea, Italy, Holstein, and more recently in America, is so vague and unprecise that it is impossible to furnish anything like a critical analysis. In the Crimea, Pirogoff recorded sixty cases, of which he acknowledges seven deaths and one subsequent amputation in consequence of the sloughing of the flap; and in the Italian war, Neudörfer performed the operation three times with success. It does not appear to have been performed at all during the Holstein war, at any rate by Danish surgeons; whilst the reports of the Surgeon-General at Washington (U.S.) record nine cases operated upon—one terminating favourably after great trouble, whilst the results of eight are not given.

Let us now compare the results of this operation with those of Syme's.

Of 219 of Syme.

Suppuration specially mentioned in	4
Sloughing of Flap	16
Died 16 (or $7\frac{15}{16}$ per cent.)	
Secondary Amputation 13 (or 6 per cent.)	
Recovered 185 (or 84 per cent.)	
Results not stated	5
Period of recovery in 40 cases varied from 3 to 52 weeks.	
29 were cured within	12 weeks.
34 " "	16 "
37 " "	24 "
The remaining 3 between 33 and 52 weeks.	

Of 58 of Pirogoff.

Suppuration specially mentioned in	11
Sloughing of the Flap	1
Died 5 (or $9\frac{9}{10}$ per cent.)	
Secondary Amputation 5 (or $9\frac{9}{10}$ per cent).	
Recovered 45 (or rather more than 75 per cent).	
Period of recovery in 13 cases varied from 6 to 69 weeks.	
11 were cured within	12 weeks.
1 " "	24 "
1 " "	40 "
1 " "	61 "
1 " "	69 "

Thus, as regards the occurrence of suppuration, the percentage of deaths, of secondary amputations, of recoveries and periods of recovery, the evidence of British surgery is in favour of Syme's operation; whilst as respects sloughing of the flap, it is decidedly in favour of Pirogoff's proceeding. Syme's operation appears to me to be unquestionably the best for disease, and Pirogoff's for accidents of civil life, since by it we preserve an increased length of limb. As to the greater facility in the performance of the latter, it does not seem to me to be worthy of much attention, neither presenting an amount of difficulty which cannot readily be overcome by an efficient surgeon.

The statistics of military surgery are too incomplete to enable us to arrive at any definite conclusion; but we can all understand that perfect rest and quiet form essential elements in the recovery after Pirogoff's operation. The necessity of keeping the remnant of the os calcis *in situ*, the tendency to secondary hæmorrhage, and suppuration in the sheaths of the tendons, confirm this, and may in no small degree account for the disparity between the success attending Pirogoff's own patients and that obtained by Professor Holloway.

This may also account for the retracted heel so forcibly dwelt upon by this surgeon, for whilst the sixty patients of the former surgeon were retained in the hospital at Sebastopol, in all probability those of the latter were moved about from place to place during the progress of their recovery.

At the termination of the Crimean war, Messrs. Mouat and Wyatt reported officially that Pirogoff had modified his operation to that of Syme. As it had proved of such value in the hands of British surgeons, I was anxious to ascertain if this was correct, and if so, what were Pirogoff's reasons for this change in his views. I accordingly wrote, and requested him to inform me whether it was the case or not.

From his reply, which I subjoin, it would appear that Messrs. Mouat and Wyatt had been misinformed; but, in justice to these gentlemen, I must add that, in the reports of the Surgeon-General, dated War Department, Washington[*] (U.S.), Nov. 1865, it is stated, that "Baron von Heronitz, Surgeon-in-Chief of the Russian Navy, in his recent visit to this office, mentioned that Pirogoff had himself abandoned his operation, finding the segment of the os calcis likely to become necrosed."

However, let Pirogoff speak for himself:

"BERLIN, *Jan.* 23, 1866.

"As to my osteo-plastic operation, I reckon nearly 100 cases in Russia alone for accident or disease. My pupil, Dr. Dzemickeritch, was the first who introduced it into the military practice at Odessa, in the case of a soldier wounded at the Alma; and his patient walked, with the assistance of a stick, in about two months.

"In the Crimea it was practised principally during the first six months of the siege, and I have registered sixty cases.

"In December, 1855, when I inspected the military hospitals at Cherson, Eckaterinoslaw, and Charkoff, I found fifteen patients who had been transferred from the Crimea, since the date of their operations. The condition of the whole fifteen was satisfactory, notwithstanding nearly half of them had received other injuries. Thus, two had also undergone amputation of the forearm. In one, my operation had been performed on both feet. One had the metatarsal bones of his other foot removed. In one the opposite leg, and in another the opposite thigh had been amputated. Two already walked upon crutches, and two even with a stick only.

"A year after the war I learned that two of the wounded admitted into the hospital at Sympheropol, having submitted to my operation on both feet, still walked on crutches. I ordered them shoes and steel supports. I only know with certainty of seven deaths, and also of one case wherein the flap sloughed, which necessitated amputation of the leg. Secondary hæmorrhage occurred in several.

"These are the results of this operation in my military practice, and judging from the number of patients so operated upon whom I saw subsequently, the mortality could not have been great. The best proof of this is, that among those who have survived some had the operation performed on both feet, some had at the same time undergone amputation of the other leg and of the other thigh.

"To be impartial, I will not speak myself of all the advantages offered by this operation with respect to the functions of the limb, but I will repeat what has been communicated to me by surgeons who have adopted it.

"During the year 1863 I visited nearly twenty hospitals and various universities of Germany, and in five of these I was shown patients operated upon according to my method. The whole walked even without sticks. But the most remarkable case was in the hospital at Heidelberg, under the care of Professor Chelius. A young woman had club feet from birth; she had tried all sorts of orthopædic treatment without benefit, and Chelius performed my operation on both feet. When this patient returned from the city to the hospital I could not discover what she wanted. She walked without a stick, and wore shoes with lateral steel supports.

"Upon subsequently examining the feet operated upon, I have invariably found the portion of the os calcis grown together with the epiphysis of the tibia. In two cases only have I detected a little movement, which, however, did not prevent the use of the limb. Nevertheless, many French and English surgeons doubt even the possibility of such an operation, and find faults discovered by themselves only. This doubtless arises from the fact that this 'Osteo-plastique' operation did not originate with themselves. Thus Syme pronounces it as an indication of reckless principles. Syme would speak more courteously if he only knew how I had supported his operation of disarticulation, when the late Dr. Arendt, inspector of hospitals at St. Petersburg, would have forbidden its employment. Another celebrated English surgeon asserts that I have myself abandoned my operation. Whence he learnt this God only knows; could he have arrived at this conclusion from one of my letters to a surgeon in London, who applied to me for the results of this operation? 'I have not yet made up my mind,' I replied. Time will show whether it is worth anything or no. Malgaigne repeats what he has read in Ferguson, and, probably never having tried my operation, frightens the reader of his 'Operative Surgery' about gangrene of the flap, the impossibility of adhesion or coalescence, fistula, and the pain experienced by the patient in walking; exactly what never takes place. The contemporaneous school, however, of Germany, has treated me much more impartially. Langenbeck, Lenhault, Neudörfer, Chelius, Busch, Beliott, and others, have frequently performed my operation with success. O. Weber has enumerated forty cases, and has defined the rate of mortality at 15 per cent. (He found the same rate of mortality in 101 cases of Syme's operation.) In seven cases the wound healed completely in one month. Dr. Kestnor, of the penal hospital at Strasburg, presents also sixteen cases. Of these the results of six as to juncture of the foot remain at present doubtful; in the other ten only one failed as to walking, and in four fistula remained. We might suppose that Malgaigne could not have ignored these results described by his countrymen in a dissertation in the French language; but he assumes to himself the credit of being the inventor of the subastragaloid amputation, although it is due entirely to his countryman, Lignerolles. Hence the reason why, at all hazards, he vaunts the advantages of his operation at the expense of others. On the other hand, Hyrtl, from purely anatomical considerations, rejects Malgaigne's operation altogether. 'As to myself I will not treat it unjustly, but will say in its favour that it preserves a little increased length to the foot, but that it is much more difficult to perform. I do not fear the result of my operation. *Its importance does not consist in the method of amputating, but in a novel osteoplastic principle;* my whole merit consists in irresistibly demonstrating by my proceeding, *that a portion of one bone remaining naturally connected with soft parts, readily unites with another, and at the same time serves to lengthen the limb and increase its utility.*'

"But few military surgeons have tried my operation. Stromeyer, without any reason, doubts its success, and in Chenu's report we cannot make out whether during the Crimean campaign the French and English surgeons made any distinction between my operation and that of Syme. Of forty-eight operations twenty-one proved fatal, or forty-four per cent.; but with the English, of twelve only two died, or sixteen per cent.

"During the Italian campaign Denne saw Neudörfer perform my operation at Verona three times; all three patients recovered.

"According to Stromeyer's report during the Holstein campaign four patients submitted to Syme's amputation died.

"Receive, &c., PIROGOFF."

"23rd January, 1866."

Pirogoff seems to have drawn his conclusions from the strictures of Syme and the report of Messrs. Mouat and Wyatt. Had he read the papers of Busk, Croft, and the other surgeons whom I have quoted, he could hardly have made the observations above. At all events, should he ever see this lecture, he will find that his censure of British surgeons is both premature and unfounded. He will see that his operation has been treated with attention, liberality, and I trust with candour. He will see also that its merits have been tested, not by forty only, but by seventy examples.

The following table gives particulars of the seventy cases here alluded to.

No.	SURGEONS. *British.*	Date.	Disease.	Sex.	Age	Life	Results. Use of Limb.
1	Ure	1855	..	..	..	D.	Disd. Brain.
2	Busk	1857	..	M.	..	..	Good.
3	"	"	..	M.	..	..	"
4	"	"	..	M.	..	..	"
5	Tudor	1858	Caries	M.	..	D.	Exhaustion.
6	"	"	"	M.	..	..	Good.
7	Pirrie	1858	"	..	..	..	"
8	Croft	1858	"	M.	..	D.	Pyæmia.
9	Partridge	1858	..	M.	..	..	Good.
10	"	..	..	..	..	..	"
11	Sir W. Fergusson	1858	Caries	M.	19	..	Doubtful.
12	"	1858	"	M.	17	..	Good, 3 mths.
13	"	1863	..	..	..	..	Good.
14	"	1864	Rly.Acdnt.	M.	20	..	"
15	"	"	" "	M.	20	..	"
16	Marsh, Northampton	1858	Gunshot	F.	29	..	"
17	Mc Ghee, Glasgow	1858	Caries	..	..	..	"
18	Williamson, Chatham	1858	"	M.	..	..	"
19	Cusack	..	..	..	..	..	Amputated.
20	Little, Dublin	..	..	..	..	..	"
21	Maunder	..	Accident	..	..	..	Good, 6 mths.
22	W. Adams	1859	Caries	..	..	..	Good.
23	Watson, Glasgow	1859	Accident	M.	14	..	Good, 3 mths.
24	" "	1859	"	M.	33	..	" "
25	" "	1859	..	M.	28	..	Good.
26	Curling	1859	Disd.Ancle	..	..	..	"
27	Bryant	1860	Caries	..	..	..	Good, 3 mths.
28	Ashdown, Northampton	1860	Accident	F.	42	..	Good.
29	Cadge, Norwich	1860	Caries	..	..	..	"
30	" "	"	"	..	..	..	"
31	Lowe, Lynn	1860	"	M.	12	..	Amputated.
32	" "	1861	"	F.	17	..	Good, 10 mhs.
33	Lambert, Birkenhead	1860	"	M.	20	..	Good.
34	" "	1864	Rly.Acdnt.	M.	18	..	"
35	Gay	1861	Caries	..	..	..	"
36	"	1862	"	..	..	..	"
37	Humphry, Cambridge	1861	"	M.	39	..	"
38	" "	1865	Accident	M.	6	..	"
39	J. P. Lansdown, Bristol	1861	Caries	M.	22	..	Amputated.
40	Gore, Bath	1862	"	F.	30	..	Good.
41	Paget	1862	"	..	..	..	"
42	"	1862	"	..	..	..	"
43	Simon	1862	..	..	..	..	"
44	"	1864	Caries	..	..	..	"
45	Edwards, Edinburgh	1863	"	F.	30	..	"
46	H. Smith	1863	"	M.	..	..	"
47	Sympson, Lincoln	1863	"	M.	..	..	"
48	Canton	1864	"	F.	..	..	"
49	H. Coote	..	Accident	..	..	D.	From Injuries
50	Hewson	1864	"	M.	10	..	Good.
51	"	1864	"	M.	48	..	"
52	Meade, Bradford	1864	"	..	..	..	"
53	Page, Cambridge	..	Accident	..	..	D.	4 days.

No.	SURGEONS. *British.*	Date.	Disease.	Sex.	Age	Life	Results. Use of Limb.
54	Shepherd, Worcester	1864	Rly. Acdnt.	M.	22	..	Amputated.
55	Wheelhouse, Leeds	1864	Accident	M.	..	..	Good.
56	Folker, Hanley	1865	,,	M.	21	..	,,
57	Jackson, Darlington	1865	,,	M.	45	D.	
58	Walsh, Worcester	1865	,,	M.	16	..	Good, 7 weeks
59	Buchanan, Glasgow	1865	,,	M.	28	..	Good.
60	H. Budd, Worcester	..	..	..	..	..	,,
61	Barber, Sheffield	1866	..	M.	..	..	,,
62	Hancock	1869	Caries	M.	10	..	,,
63	,,	1870	,,	M.	37	..	,,
64	Canton	1867	,,	M.	16	..	,,
65	Wood	1867	,,	M.	25	..	Not stated.
66	Heath	1868	,,	M.	16	..	Good.
67	Birkett	1867	Accident	M.	45	..	,,
68	Cradock, Shepton Mallet	1871	,,	M.	20	..	,,
69	,, ,, ,,	1871	Caries	F.	48	..	,,
70	J. D. Hill	1871	Accident	M.	45	..	,,

SURGEONS. *Foreign.*	Date.	Disease.	Sex.	Age.	Life	Results. Use of Limb.
Pirogoff	..	Nrly. 100 cases	..	..	..	..
Masch	1860	Gunshot	M.	29	..	Good.
Carnaz	1861	Accident	M.	29	..	,,
Neudörfer, Italian War	..	3 cases	..	..	..	,,
Eve, Nashville, U.S.	1863	Gunshot	M.	25	..	Amput. 5 mths.
Holloway, Louisville, U.S	1863	,,	M.	..	..	Not good.
,, ,,	1864	3 cases	..	..	..	,, ,,
Gilmore, Mississippi	1864	Gunshot	M.	..	D.	..
American War Reports	1865	9 cases	..	..	..	1 gd., 8 not stated
Weber, Germany	..	40 cases	..	..	..	..
Kestnor, Strasburg	..	16 cases	..	..	..	..

LECTURE V.

LIGNEROLLES OR SUBASTRAGALOID AMPUTATION.

Mr. President and Gentlemen,

Thus Mr. Syme accuses Pirogoff of reckless surgery in bringing forward his plan of operation, and Pirogoff, in his turn, accuses Malgaigne of plagiarism, and of vaunting his method at the expense of others, in proposing *his* operation of subastragaloid amputation.

In treating of amputation at the ankle-joint, at page 299 of the second volume of his "Operative Surgery," dated 1839, Velpau says that M. de Lignerolles had communicated to him an improvement which might be the means of restoring this operation to practice. "Leaving the astragalus, he would only remove the os calcis with the foot; and would thus have, instead of the malleolar projections, a nearly flat broad surface at the end of the stump. In this case the flaps must be made from the sides of the foot, and be reflected towards the malleoli before the foot is disarticulated." The operation was performed for the first time by Textor in the year 1841; and in 1846 Malgaigne read a paper before the Academy of Medicine in Paris describing his method, which is that indicated by Lignerolles, and consists in removing all the bones of the foot except the astragalus, the connexions of which with the tibia and fibula he leaves unmolested, and thus preserves the ankle-joint intact. He performed his first operation in 1845, and the following is his plan of proceeding, taken from the seventh edition of his Manual:—He obtains his flap from the inner part of the sole of the foot. Placing his knife over the tendo Achillis, he cuts through skin, tendon, and fat, down to the bone or upper surface of the os calcis; he then continues the incision along the outside of the foot just below the external malleolus, turns it up over the dorsum of the foot a little in front of the medio-tarsal joint, then over the inner border of the foot, and across the sole of the foot for the inner two-thirds of its breadth. By this incision he divides everything down to the bone. Then, transferring his knife to the inner extremity of the first incision (over the tendo Achillis), he cuts obliquely downwards, at an angle of forty-five degrees, on to the sole of the foot, until he joins the other incision, thus completing his flap. This he reflects first from the sole of the foot, taking care to include all the soft parts except some of the tendons nearest the bone; next from the inner side and dorsum of the foot, until the articulations between the os calcis and astragalus, and between the latter and the scaphoid, are exposed. This flap being held back by an assistant, he proceeds to open the medio-tarsal articulation, or that between the astragalus and the scaphoid, and at the same time divides the external calcaneo-astragaloid ligament; and, introducing his knife horizontally beneath the head of the astragalus and between this bone and the os calcis, he cuts backwards, following the direction of the anterior calcaneo-astragaloid articulating surface, through everything he meets with, until, the division of the anterior fibres of the interosseous ligament allowing the bones to be separated, the operation is completed without farther difficulty.

He admits that the flap may be made in front from the skin covering the dorsum of the foot, or behind from the integuments covering the heel, as in the tibio-tarsal amputation; but he prefers the mode of proceeding just related.

It will be observed that, with the exception of one flap being made in this method instead of two, the operation here described in no way differs from that suggested by Lignerolles, whose name, curiously enough, is entirely omitted from the paper. Nor is the slightest allusion made to Textor's operation, or to the announcement by Velpeau; although, as we have already seen, the former was performed in 1841, whilst the latter was published in the year 1839—seven years before Malgaigne submitted his proceeding to the Academy of Sciences.

Subastragaloid amputation, although an excellent proceeding in proper cases, has not been warmly supported in France; whilst in England it scarcely appears to be known, if I may judge from the replies to my enquiries. Malgaigne says that he has performed it six times; and that exclusive of these M. Vacquez has collected eleven other observations, including one performed by Nélaton. In England, as far as I know, it has, up to this time, been performed only by Mr. Simon, Dr. John Traill of Arbroath, Mr. Garner of Stoke-upon-Trent, and by myself. As the operation is in reality a very good one, and one which in proper cases may be adopted with great advantage to the patient in preference either to Syme's or Pirogoff's, we can only attribute this neglect to the fact of its not being sufficiently known. Its advantages may be very briefly stated, that whereas both in Syme's and Pirogoff's proceedings the ankle-joint is of necessity sacrificed, in subastragaloid amputation, not only the ankle-joint, but at the same time an increased length of limb is preserved.

True it is we are told that Hyrtl, from purely anatomical considerations, rejects this operation altogether, and it would seem that Pirogoff endorses his views; but he does not inform us in what these anatomical considerations consist, and I must confess my inability to do so myself, for I am not acquainted with a single fact connected either with anatomy, physiology, or pathology, which in judiciously selected cases would militate against it if properly performed.

In advocating this proceeding, I do not for one moment pretend that it will or ought to supersede Syme's or Pirogoff's methods altogether. They, I believe, will always maintain their ground. They can be performed when this cannot. But I am equally confident that the two former have frequently been selected in instances wherein the latter might have been performed with greater advantage to the patient; and I also feel certain that, when this operation of subastragaloid amputation becomes more generally known, surgeons will study their cases more closely; they will pay greater attention to the selection of their operative proceedings, and it will be more frequently adopted. Mr. Syme justly claims an increased length of limb and a stump formed of structures especially supplied by nature to sustain pressure and to enable man to walk thereon. Pirogoff and his supporters claim superiority for his proceeding over that of Syme in that his (Pirogoff's) operation is more easily performed, that by it a still greater length of limb is obtained, and that, whilst the same soft structures enter into the stump, a new osteo-plastic measure or principle is introduced in obtaining union between the cut surface of one bone with another, the other being a different bone from that with which nature originally designed it to articulate. For subastragaloid amputation I claim equal facility of execution with that of Pirogoff, and length of limb equal to that afforded by the latter; but whereas in the latter this increased length of limb is obtained by a piece of bone transplanted, so to speak, to new ground, to an abnormal situation, the former supplies it by a non-disturbance of parts, by the preservation, in fact, of the astragalus in its natural position. Another advantage consists in the dorsal incision being made over the medio-tarsal joint, or a little anterior to it, instead of being carried in front of the ankle-joint. By this means the sheaths of the extensor tendons are left undisturbed, and consequently the risk of inflammation and suppuration within those sheaths and in the course of the tendons is materially diminished.

But the great superiority of this operation over those of both Syme and Pirogoff is that by it the ankle-joint is preserved intact, whilst a stump of natural heel structure is equally obtained.

A surgical writer of considerable reputation, in treating of subastragaloid amputation, ignores Malgaigne's mode, and advises the heel flap to be made as in Syme's. He adds: "A good, long, and useful stump results; but the number of cases requiring it must be small, as it does not often happen that the calcis, with the anterior range of tarsal bones, are diseased without the astragalus also being involved."

Mr. Syme objects to the operation altogether; "that Dr. Traill, of Arbroath, lately sent a communication, with cast, to the Medical Society of Edinburgh. He says truly that cases in which the astragalus could be left must very rarely occur, since disease affecting the tarsus at all generally involves the astragalus; but I (Mr. Syme) think it would be very undesirable to leave this bone, even when it is not affected at the time of the operation, on account of the predisposition to caries, one of the great recommendations of amputation at the ankle being that it removes all the bones liable to disease."

Nothing, it must be allowed, can be more sweeping, nothing more condemnatory of the tarsal bones, than are these opinions. The first asserts that it does not often happen that the calcis and anterior range of tarsal bones are diseased without the astragalus being involved also. The second lays down, that when disease affects the tarsus at all it generally involves the astragalus. Whilst the third maintains, never mind whether the astragalus be sound or not at the time of operation; it is predisposed to disease, and therefore should always be removed.

These opinions are so extreme that I must be excused for doubting whether their authors, when they promulgated them, had duly considered, what the practical result would be if they were implicitly followed. That they have influenced the profession, and that they continue to do so, all who read the recorded surgery of the foot must admit, and consequently if erroneous the sooner their influence is dissipated the better. They are either of great value or they are actually mischievous. They negative all efforts at improvements in the surgery of the foot; they condemn resections of bones; they condemn partial amputations; in a word, they condemn all operative procedures, save that of removal of the foot at the ankle-joint. They virtually ordain that if disease appears in a tarsal bone, never mind how limited that disease may be, you must amputate at the ankle-joint at once. It is no use your removing an isolated bone; it is no use your attempting to preserve any portion of the foot; the tarsal bones, whether diseased or not, are predisposed to disease, and therefore the sooner they are all sacrificed the better.

If these opinions are so strongly opposed to the preservation of bones not yet implicated, how decidedly fatal must they be to the proceeding of gouging away, or attempting to gouge away, the portions of bones in which disease has already manifested itself; for if the remaining bones not yet implicated are so predisposed to mischief that they ought of necessity to be removed, it is sheer folly to imagine that gouging away a diseased portion of bone can have the effect of converting the remainder into such a perfectly sound condition as to emancipate it from this predisposition. Yet we find the following case reported by the high authority to whom I have alluded:—

"The ankle-joint appeared sound; the articulations on the inner side of the foot were sound; there were several fistulous openings on the outer side of the foot, and the probe found the outer side of the os calcis diseased. Another opening led to the diseased astragalus, and another to the cuboid. The disease appeared to be limited to the upper and anterior part of the os calcis, the anterior and outer portion of the astragalus, and the posterior of the cuboid. *The parts were gouged away*, and in so doing the large anterior synovial membrane between the scaphoid and cuneiform was laid open. The day after severe erysipelas set in, followed by suppuration in the sole and inner part of the foot, and the patient became so weak that amputation of the leg was obliged to be had recourse to."

Now as I have not this dread of "predisposition," as I believe that caries of the tarsal bones frequently results from disease originating in the soft structures of the tarsal joints, and as frequently extends to the bones from mere contiguity of surface, and, moreover, that the removal, without violence, of the carious portion of a bone will frequently arrest the disease in that bone altogether, I should say that, circumstances contradicting Teale's operation, the case just related was one to which subastragaloid amputation was especially adapted, when performed according to the method which I shall presently describe.

I would submit, moreover, that the operation may also be performed with great advantage in such cases as the following related by Mr. Skey. In November, 1858, he removed a considerable amount of diseased tarsal bones from the right foot of a patient. The case went on well for a month, when the disease returned, and in May, 1859, Mr. Skey operated again. In his clinical observations, alluding to the proportion of failures in these attempts (one in every three), he says it might have been preferable to have amputated, but that he desired to give the man a chance. As the ankle-joint does not appear to have been implicated, I should in similar cases prefer subastragaloid amputation in the first instance to gouging; and in the event of the latter having been tried and failed, I would certainly select the former rather than repeat the gouging or have recourse to amputation of the leg.

In one case, instead of taking the flap from the sole of the foot, Malgaigne obtained it from the dorsum. The patient, a woman aged forty-two, had for three years suffered from disease extending from the scaphoid to the os calcis, but the ankle-joint remained sound. Gouging was had recourse to in the first instance, but the patient getting worse, Malgaigne operated by a dorsal flap. This sloughed away, but the wound ultimately cicatrized. The patient, however, subsequently complained that the weight of the body bore too much on the head of the astragalus, which in fact descended lower than the rest of the bone. By degrees she got over this, and when she left the hospital in April, 1846, she could walk comfortably.

Maisonneuve appears to have performed the third subastragaloid amputation in France. He first cut the skin across at the posterior part of the heel;

then, bringing his knife forwards beneath the external malleolus, cut from behind forwards along the outer border of the foot to the roots of the toes, so as to make a flap involving the skin of the entire dorsum of the foot. The flap united, but the patient subsequently suffered greatly in walking, from the pressure on the head of the astragalus, which descended lower than the malleoli, the posterior part of the bone being apparently drawn up by the contraction of the tendo Achillis.

M. Malgaigne also relates the case of a soldier operated upon before Sebastopol, in whom the astragalus, drawn up behind by the tendo Achillis, became anchylosed to the tibia, and thus prevented the stump resting flatly on the ground.

In the year 1848, Mr. Simon introduced the operation into this country in the case of a boy aged fifteen, suffering from scrofulous caries affecting the front and outside of the tarsus, extending to the os calcis, but sparing the astragalus. Having ascertained that the astragalus and ankle-joint were healthy, Mr. Simon made his flaps as in Syme's amputation; and, introducing his knife between the astragalus and calcis by cutting from before backwards, detached the foot. The boy recovered with a good and useful stump; and, when seen several years afterwards, could walk well and without inconvenience.

Mr. Simon's second case was not so successful, although the fatal termination can scarcely be ascribed to the operation, performed on a railway labourer, aged twenty-five years, admitted into St. Thomas's Hospital in the summer of 1853. A carriage wheel had passed obliquely over his foot from behind forwards and inwards, crushing everything in front of the line of the incision, and breaking and exposing the under part of the os calcis. The same amputation was performed as in the former case. The stump was nearly healed, and was apparently as satisfactory as could be wished, when, about a fortnight after the operation, the patient died of tetanus.

Both Malgaigne and Maisonneuve allowed the head of the astragalus to remain; and we are led to infer that Mr. Simon pursued the same practice. In the two former instances we have seen that great suffering and inconvenience followed this practice, resulting from the tendo Achillis forming fresh attachments, and drawing the posterior portion of the astragalus up into the mortise of the tibia and fibula, by which the head of the bone, rendered unduly prominent, was forced downwards; so that the patients in walking rested on this process, instead of upon the broad under surface of the bone, as they should have done. This inconvenience may be entirely prevented by removing the head of the astragalus at the time of operation, which can be done with perfect safety, and certainly a much better stump results from such proceeding.

On the 24th September, 1863, the girl a portion of whose foot I had amputated by sawing through the cuneiform and cuboid bones, and whose case I alluded to in my second lecture, was readmitted with inflammation and pain in her other (the right) foot. The right ankle-joint appeared to be much swollen and inflamed, especially over its anterior and outer aspect. Entire rest upon a splint was ordered. The joint, however, still remained swollen, thickened, and painful, and at length the skin on the outer side ulcerated. Under tonics and nourishing diet, with perfect rest, the patient appeared to improve; but at the expiration of six months she became rapidly worse: several wounds opened in the neighbourhood of the joint, instep, and beneath the sole of the foot, with sinuses leading to the bones in various directions. As her general health was giving way, I, in March, 1864, recommended the girl to have the foot removed at the ankle-joint; and she having consented, I proceeded to perform that operation. But a more careful examination under chloroform led me to doubt the necessity of sacrificing the ankle-joint. I consequently made an exploratory incision on the outside of the foot, and with my finger found that the astragalus was sound, whilst the freedom with which the foot could now be flexed and extended showed also that the ankle-joint was free from implication. Under these circumstances, with the concurrence of my colleagues, I performed the subastragaloid amputation by flaps as in Syme's operation, differing only in making the posterior flap fuller than that advised in the latter proceeding.

In consequence of the amount of disease in the os calcis the soft parts had become detached, so that very little difficulty was experienced in separating the posterior flap from the bone, or in subsequently introducing the knife between the astragalus and calcis and cutting the interosseous ligament. Having thus detached the whole of the foot with the exception of the astragalus, I next removed the head of the astragalus, sawing through the neck of the bone, and, bringing the flaps together, united them by two or three sutures, taking care to leave their angles unclosed so as to admit of free discharge. The stump healed gradually, and without a single untoward symptom. The patient's health slowly but surely improved, and at the end of three months she was discharged, being able to bear her weight upon her stump and hobble about upon crutches. After a few months Mr. Ernst, the surgical mechanician, fitted her with artificial feet; and she is here in the College to-day for the purpose of being examined, if you, Sir, and the rest of my hearers, would desire to do so. You will find that both the stumps are entirely healed, and sound. It is now more than two years since the last operation, and nearly three since the first. Notwithstanding the amount of disease in the tarso-metatarsal joints, and the proximity to those joints at which I sawed through the tarsal bones, as you have already seen in the preparation before you, the stump has remained sound to the present day, and in the condition in which you will now find it. The stump resulting from the subastragaloid amputation appears to me to be perfect. It is round and of good form; the cicatrix is firm and well up in front; and the bottom of the stump is properly covered by the natural heel-tissue. She has a certain amount of motion of the ankle-joint, and can now walk with the assistance of a single crutch. Not, as she will tell you, that she requires the crutch from inability to bear her weight upon the stumps, but because, as she says, the loss of the front of her feet causes such a strain upon the lumbar muscles when she walks without the crutch that she is prevented doing so by the pain referred to that situation.

Subastragaloid amputation appears to have been performed up to this time in twenty-two cases. By M. Malgaigne six times, by M. Maisonneuve once, by M. Nélaton once. M. Vacquez has collected nine other cases, all of which are stated to have terminated favourably. In Scotland, Dr. John Traill, of Arbroath, performed it once successfully. In England, Mr. John Simon has performed it twice, once successfully, and in the other case the patient died at the end of a fortnight of tetanus. Mr. Garner, of Stoke-upon-Trent, operated in one case, but he does not report favourably. And, lastly, I performed it once, in 1864, successfully.

Thus we have three amputations connected with the ankle-joint: first, Syme's, removing all the bones of the foot, furnishing an excellent stump, but the shortest limb; Pirogoff's, removing all the bones of the foot except the tuberosity of the os calcis, also supplying an excellent stump, and a limb as much longer as the quantity of os calcis preserved; and, lastly, the subastragaloid amputation, by which the astragalus and ankle-joint are saved, and an equally good stump and length of limb are bestowed on the patient as by Pirogoff's method. Good as the subastragaloid amputation undoubtedly is, and satisfactory as have been the results in the case just related, it is in fitting cases capable of improvement in two essential points—first, in the length of the limb, and, secondly, in the amount of leverage afforded for an artificial foot, and the consequent effects upon the movements of the ankle-joint. Cases may occur in which, whilst the astragalus remains sound, disease or accident involving the other tarsal bones extends only to the anterior portion of the os calcis; as in the first case of Mr. H. Budd, of Worcester, in which the astragalus and os calcis alone remained uninjured, and the sound integuments were too scant to admit of a Chopart's amputation. Here a modification of subastragaloid and Pirogoff's amputation may be more beneficially employed, namely, to leave the ankle-joint intact, to remove the head and under surface of the astragalus, and cut away the whole of the os calcis with the exception of its posterior third, bringing that portion up and adapting it by its cut surface to the under surface of the astragalus. Upon mentioning my views to my colleague, Mr. Canton, he not only entered into them warmly, but, with that courtesy for which he is proverbial, offered me the first case he might have to which the proceeding could be applied. He kept his promise, and by his great generosity I am now enabled to present you, not merely with a theoretical description, but with a living proof of the success of an operation that has never, I believe, been performed before, either in this or in any other country.

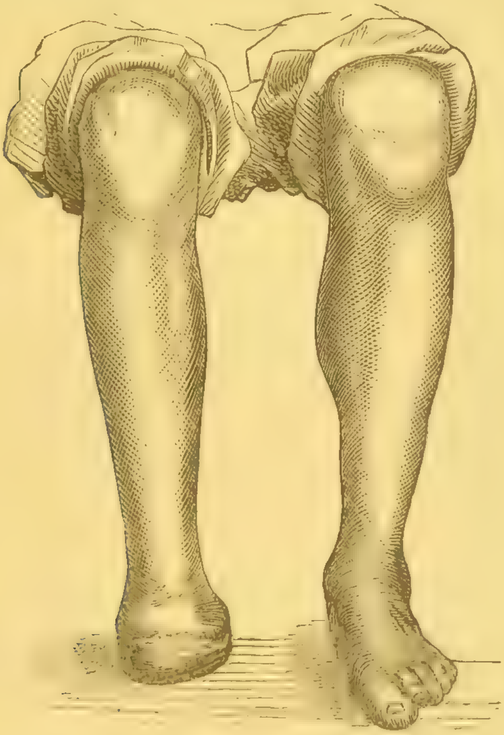
The patient, aged twenty-four, a native of Ayrshire, about twenty years ago, during the winter, observed that his great toe became swollen and inflamed. He did not attach much importance to this at the time, as others of his family had their feet and toes similarly affected, caused, as it was supposed, by frost; and consequently no especial notice was taken of his condition. After continuing some time in this swollen state, matter formed, and discharged by three openings, all, as it were, connected interiorily. It next suppurated on the dorsum of the foot at three places, extending in a straight line from the great toe as far as the instep. Under treatment, however, these wounds gradually healed up, and have remained so. For a considerable time, it might be two or three years, the disease was confined to the toe, and a peculiar excrescence was formed and gradually increased, but gave him little pain, so that he could go to school, or do what he was able about a farm of ninety acres which his father tenanted, with slight inconvenience, although there was always more or less discharge. The next suppuration was towards the outside of the foot and near to the toes: it gradually formed into an excrescence similar to that on the toe, but this was removed by means of caustic, after which it quite healed up. By-and-by, however, new wounds formed round where the others had been, and remained until the operation. About twelve years ago the disease in the sole of the foot commenced, and since that period there have been several abscesses on the leg at different times and in various places, all of which, after festering, soon got well under treatment, and there has been no disease save that in the foot for several years. Until the last two years the disease had not materially interfered with his walking, but since then it has become much more troublesome from an acute pain in the region of the heel and ankle. He has always lived in the country, and enjoyed pretty good health except when matter was forming. He is the youngest of six sons, and has two sisters younger than himself, all healthy and strong. His father died at the age of seventy-six, and his mother is still alive, and the relations of both are strong and healthy people. In the winter of 1864-5 the little finger of the hand on the same side as the diseased foot became similarly affected, and has remained so ever since.

When admitted into Charing-cross Hospital the patient presented a well-marked example of the fair variety of scrofula. The foot was generally swollen and somewhat distorted. The soft parts had a brawny hardness. The great toe was so enlarged and misshapen as to appear elephantoid. In front of the ankle-joint, and particularly on the dorsum of the foot, there were many larger or smaller ulcerated openings, which gave issue to a strumous form of pus, without, however, such odour as would indicate the existence of diseased bones, nor did examination with a probe show that these latter were affected. All the joints seemed to be perfect, and it gave him no pain or inconvenience when they were moved.

No plan of treatment, either local or general, having ever been of any avail, it was decided that the disease should be removed by operation; and, as I have before said, Mr. Canton most kindly allowed me to carry out my proposition, assisted by himself and my two other colleagues, Messrs. Hird and Barwell.

The patient having been placed under the influence of chloroform by Mr. Marshall, I commenced an incision beneath, and at the posterior angle of the external malleolus, and carried it forwards along the outer border of the foot to a point about half an inch anterior to the projecting base of the fifth metatarsal bone. I then made a second incision along the inner border of the foot, commencing posteriorly about the centre and beneath the internal malleolus, and terminating anteriorly at a spot corresponding to the termination of the external incision, and then united the two by a third and semilunar incision, carried, with its convexity directed towards the toes, across the front of the sole of the foot well down to the bones. Reflecting this flap back as far as the projections on the under surface, and in front of the tuberosity of the os calcis, I carried a fourth incision across the dorsum of the foot, immediately behind the head of the astragalus. Then applying a saw upon the under surface of the os calcis as far back as I could, I cut through the bone obliquely from below upwards and backwards. Next, resuming my knife, I entered the mediotarsal articulation, and passing the instrument under the head of the astragalus, and cutting from before backwards, in the direction of the anterior articulating surface on the os calcis, divided the interosseous ligament, and detached the front of the foot. I then sawed off the head of the astragalus, and with a pair of bone cutters (curved on the flat) removed the two articular cartilages on the under surface of this bone, and securing the two plantar arteries, thus completed the operation. The flaps were brought together by three wire sutures in front, the lower angles of the wound being left open. The patient went on remarkably well. There has been no suppuration in the course of the tendons, no secondary hæmorrhage, nor any constitutional disturbance. A very few days after the operation he said he was much more comfortable than he was before it was performed. He is now waiting in an adjoining room that you may examine him for yourselves; and, as I believe the operation to be original, I have ventured to designate it in the table before you as my own.

The following woodcut engraved from a photograph, taken from the patient before he returned home, shows the length of the stump as compared with the sound limb:—



Since the foregoing was written, I have received the following satisfactory letter from my patient:—

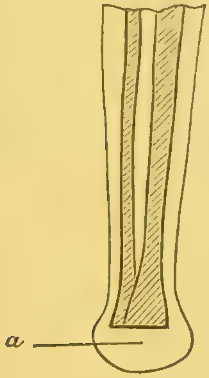
"CLUNY HILL, FORRES,

"22nd November, 1866.

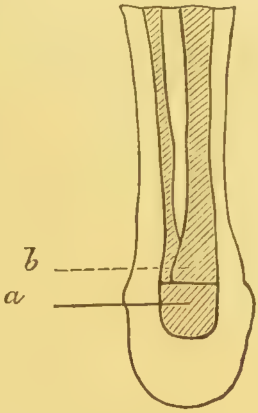
"DEAR SIR,—It affords me great pleasure again to inform you of the progress of my stump, and to say it has greatly improved since I last wrote you; so much so, that the wounds are now entirely closed, except a small part of the old sore, which is still a little open, but also improved. My stump can now bear the pressure of eight stones without inconvenience to me. Many thanks for your very kind letter, and with much esteem and sincere gratitude,

"I remain,
"Yours most respectfully,
R. M."

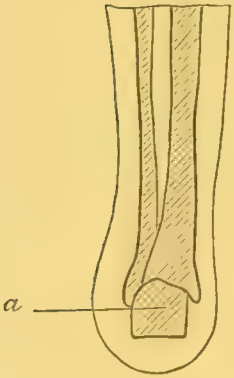
The annexed woodcuts show the skeleton of the stump after Syme’s, Pirogoff’s, Lignerolles’, or sub-astragaloid, and my amputations.



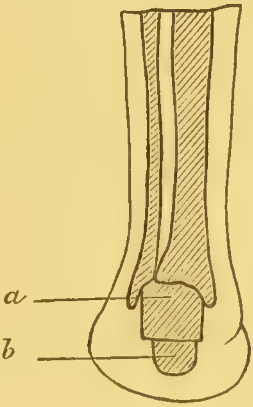
A



B



C



D

A Syme’s Stump formed by integuments of heel brought up to cut ends of tibia and fibula (*a*).

B Pirogoff’s Stump formed by the tuberosity of the os calcis (*a*) retained in integuments of heel brought up to cut ends of tibia and fibula (*b*).

C Lignerolles’ Ankle-joint intact Stump formed by integuments of heel brought up to under surface of astragalus (*a*) from which the articular cartilages have been removed.

D Hancock’s Ankle-joint intact Stump formed by tuberosity of os calcis (*b*) retained in integuments of heel, and brought up to under surface of astragalus, from which the inferior articular surfaces, together with its head, have been removed (*a*).

DISLOCATION OF THE ASTRAGALUS

WITH THE LOWER ENDS OF THE TIBIA AND FIBULA.

Placed between the lower end of the tibia and the foot, destined not only to sustain the weight of the body and to transmit it to the foot, but to effect this under all circumstances and at all angles—unaided by muscular attachments, connected posteriorly with the os calcis by ligaments only, but loosely in front with the almost plain surface of the scaphoid bone, and allowed a considerable amount of motion, it is not surprising that the astragalus should frequently be displaced, that such displacements should occur in almost every direction, and that it should sometimes be isolated from its natural situation altogether; that it should cling to the tarsal bones, on the one hand, allowing the bones of the leg to be separated from it, and, on the other, that it should cling to the latter and desert the former.

Mr. Turner, of Manchester, the great English authority on dislocations of the astragalus, enumerates eight varieties as to direction—namely, forwards, inwards, outwards, backwards, forwards and inwards, forwards and outwards, outwards and upwards, and outwards, downwards, and backwards. He also classifies dislocations of the astragalus under two heads—partial and complete, subdividing the latter into direct and indirect, and both into simple, compound, and complicated—*i.e.*, with fracture. In all these varieties the head of the astragalus has left the scaphoid cavity; but on the table before us we have a preparation belonging to my colleague, Mr. Canton, in which the displacement is confined to the body of the bone, its head remaining *in situ.* The preparation was taken from a body sent in for dissection; the symptoms during life, or the nature of the accident, therefore, could not be ascertained; but the form of displacement is so unusual that I would fain refer you for an account of the dissection of the part to Mr. Canton's work, "Surgical and Pathological Observations."

In the year 1844 I read a paper before the Medico-Chirurgical Society directing attention to a very rare form of accident—namely, "Dislocation of the Astragalus with the lower ends of the Tibia and Fibula inwards." At that period, although I took great pains in the matter, I could only meet with the accounts of three cases of a similar nature.

Case 1 is related by the late Sir A. Cooper. "Here," he says, "the protuberance of the os calcis had nearly disappeared; but the os calcis laterally, and on the outer side, projected much beyond the outer malleolus, under which, however, was a remarkable depression. Just below the inner malleolus was a remarkable and unnatural projection: the whole foot seemed somewhat displaced outwards, the toes turning out. The dislocation was reduced, and the patient recovered."

Case 2 is described by Dupuytren as "a fracture of the fibula, with dislocation of the foot inwards." The inner malleolus with the astragalus projected inwards; the foot was thrown outwards, with a considerable cavity in the situation of the external malleolus. The dislocation was never reduced.

Case 3 is that of the preparation before you, taken from an old man who, two years before his death, fell down stairs and dislocated his ankle. The dislocation was never reduced, and the patient could only walk with the aid of a stick. The late Mr. Howship, who attended him at the time of his death, relates that at that time the axis of the tibia was directed inwards and forwards, the foot projecting externally with the sole looking downwards. There was a considerable projection of the inner malleolus, with fulness and swelling of the outer ankle. The preparation shows that the astragalus, with the lower ends of the tibia and fibula, had been thrown inwards, the lower and posterior portion of the external malleolus resting on the superior and internal surface of the protuberance of the os calcis, immediately in front of the insertion of the tendo Achillis. The tibia, fibula, and astragalus are anchylosed together, and are united by a similar process to the os calcis. The direction of the astragalus is completely reversed, now being from behind forwards and outwards, but its head remaining articulated with the scaphoid bone. Obliteration of the astragaloid cavity has commenced by the deposition of ossific matter on the posterior articulating surface. The calcis is somewhat separated from the cuboid bone. At the lower end of the fibula is a remarkable hook-like process of newly-formed bone, placed at the anterior margin of the external malleolus, with a groove or canal directed from behind forwards for the lodgment of the tendons of the peronei muscles, which, having been deprived of their normal support by the displacement of the fibula, were thus adapted to the altered relation of parts. The bones of the great toe are drawn inwards, in all probability from the tendon of the flexor longus pollicis having been kept for so long a period upon the stretch.

The following are the particulars of my own case :—

J. M——, a strong, healthy man, aged twenty-four, was admitted under my care into Charing-cross Hospital on Saturday evening, 5th December, 1840. I saw the man on the following Monday. The fibula was fractured at about three inches above the external malleolus ; the axis of the tibia, instead of falling on the centre of the foot, was thrown inwards and slightly forwards, giving the leg the appearance of being twisted in that direction. The position and direction of the foot were not materially altered, excepting that it projected greatly outwards and the toes turned slightly outwards; but its dorsum looked directly upwards, as in the natural condition. Carrying my finger along the outer border from the heel forwards, I could feel the anterior extremity of the os calcis uniting with the cuboid very distinctly; whilst above was a considerable cavity in place of the prominence formed by the astragalus and external malleolus. I could likewise, by pressing my finger along the dorsum of the foot, distinguish a cavity behind the posterior margin of the scaphoid bone. On the inner side of the foot was a prominence corresponding to the internal malleolus, of which the lower margin could be distinctly defined; and anteriorly and inferiorly another projection, more prominent, evidently caused by the head of the astragalus, over which the skin was tense, thin, and vesicated. The distance between the lower end of the inner malleolus and the sole of the foot was diminished about an inch. The ankle-joint was still capable of flexion and extension, and there was considerable motion in the centre of the foot corresponding to the calcaneo-cuboidal articulation, forming as it were a double joint. From the projection outwards of the foot, the direction of the tibia (downwards and inwards), the situation of the projections on the inner side of the foot, the cavities on its upper and outer surfaces, the absence of the external malleolus, the increased pliability of the centre of the foot, the integrity of the ankle-joint, and the different measurements already described, I concluded that the astragalus had been forced from without inwards from the upper surface of the os calcis, carrying with it the lower ends of the tibia and fibula; and I consequently designate the accident a dislocation of the astragalus with the lower ends of the tibia and fibula inwards, as denoting the parts actually displaced. After considerable difficulty I succeeded in reducing the dislocation; but three days afterwards the integuments over the point of pressure sloughed, as did subsequently the internal calcaneo-scaphoid ligaments. The astragalus, thus no longer restrained, gradually twisted round upon the os calcis, until at length a large portion of its head projected through the wound. I therefore with a saw removed the protruding portion, and the patient recovered and left the hospital seven months after the accident. I saw him four years afterwards. He could then walk without stick or artificial support of any kind, and was able to do his work at Messrs. Combe and Delafield's brewery as well as ever.

I believe that I was the first to point out the true character of this accident, which, as we have seen, is one of very unusual occurrence. It is certainly very gratifying to find one's labours appreciated. I have the double gratification of finding my labours not only appreciated by M. Vidal de Cassis, but appropriated by him word for word in his "Pathologie Externe," without the slightest acknowledgment of the source whence he obtained his information. And I have the additional gratification of finding an old friend and pupil publishing a paper upon this same accident, and quoting M. Vidal de Cassis as the great authority on the subject.

In the *Medical Times* of 1845–46 we read of a patient taken to Guy's Hospital labouring under simple dislocation of the astragalus from the calcis and scaphoid, retaining its connection with the tibia and fibula without fracture of these bones. All attempts at reduction failed, and, constitutional symptoms having supervened, the leg was amputated. The tibialis posticus was found displaced from the natural groove on to the front of the tibia, and the flexor communis digitorum from the same groove into that of the flexor longus pollicis. The posterior tibial nerve was violently stretched. The patient died in a few days.

Dr. Fayrer, the senior surgeon of the Medical College Hospital at Calcutta, relates a similar case in his "Clinical Observations in Surgery," under the title of Subastragaloid Dislocation. The parts were reduced under chloroform. Iced water was applied continuously for forty-eight hours, and the patient did remarkably well.

Since the delivery of this lecture, Dr. Wilson, of Clay Cross, Derbyshire, has kindly furnished me with the following case, for the notes of which I am indebted to Mr. Grellet, of Oxford, late assistant-surgeon to the Clay Cross Collieries.

A man was admitted into the Clay Cross Colliery Hospital, on 8th August, 1866, with complete compound dislocation at the left astragalo-scaphoid joint; the foot with its sole turned inwards and upwards, and the tibia, fibula, and astragalus protruding through a wound four inches in length on the outside of the instep. There was no fracture whatever, and the astragalus, whilst retaining intact its articulation with the tibia, was completely torn away from the scaphoid and os calcis. The displacement was reduced, the wound brought together with sutures, and a splint applied to the inside of the left foot and leg, which were placed on a pillow, the leg being flexed, and its inner side resting on the pillow.

October 15.—Wound of dislocation quite healed. The astragalus can be felt through a wound on the inner side as if it were being gradually thrown off by necrosis.

Small sinuses continued to open and heal up; dead bone was felt, and apparently the entire astragalus was dead. The man, however, got sufficiently well to be discharged from the Hospital at Christmas, 1866. He continued to attend as an out-patient, but any long walk occasioned erysipelatous redness over the instep. His general health throughout was fairly good.

LECTURE VI.

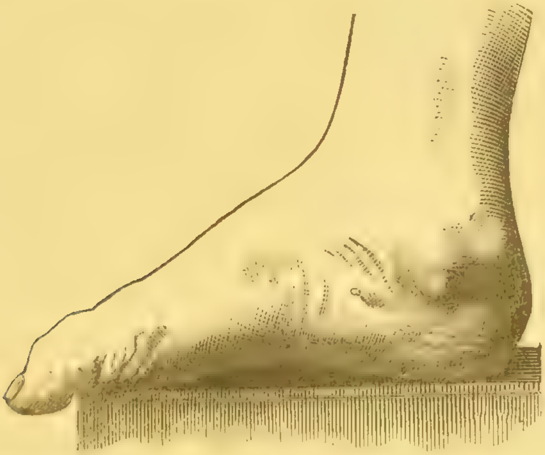
EXCISION OF THE ASTRAGALUS.

MR. PRESIDENT AND GENTLEMEN,

I will not attempt to describe the directions in which the force must necessarily be applied to cause the various dislocations of the astragalus enumerated in my last lecture. The inquiry would at best be but theoretical, and would lead, I fear, to but little practical information. I therefore propose in this lecture to confine myself to the consideration of the principles of treatment of dislocation of the astragalus itself, uncomplicated by displacements of other bones; and for this purpose I would restrict these accidents to four classes—namely, Partial, Complete, Simple, and Compound: the latter including all cases with direct wounds, whether complicated with fracture of other bones or not.

The great desideratum here, as in dislocations of other joints of the body, is undoubtedly *reduction;* but the distinction between dislocations of the astragalus and those elsewhere consists in this: that whereas, in the latter, if reduction cannot be effected comparatively little inconvenience results beyond the loss of the joint and the consequent deterioration of the use of the limb; in the former, the displaced bone, acting as a foreign body, creates such an amount of local mischief and constitutional disturbance as not only to menace limb, but life, and frequently to require a serious and difficult operation to avert the consequences threatened.

In treating of reduction, we cannot overlook the obstacles which present themselves in the obliteration of the space previously occupied by the astragalus, from the drawing together of the tibia and os calcis by the action of the muscles surrounding the ankle-joint, in the direction of the dislocations, which, as we have seen, presents eight varieties—forwards, backwards, inwards, outwards, forwards and inwards, forwards and outwards, outwards and upwards, and outwards, downwards, and backwards; and lastly, in the situation, condition, and position of the bone displaced.



I am indebted to Dr. Hulme, of Dunedin, for the photograph whence the wood-cut is taken, representing the comparatively rare form of dislocation of the astragalus backwards and inwards.

The extent to which the space previously occupied by the astragalus is obliterated will depend very much upon the length of time which has elapsed between the accident and the period at which the efforts at reduction are made. If seen soon after the accident, there will be comparatively but little diminution of space, as long muscles, when called upon to accommodate themselves to altered relation of parts, do not at once effect their greatest contraction, but shorten by degrees. True it is that when this shortening is accomplished, it becomes more confirmed, and is overcome with greater difficulty as time progresses, until at length the cavity is entirely obliterated.

We must remember, however, that the progress of science and surgery has furnished us with means of overcoming these obstacles which were unknown to our forefathers. Chloroform and tenotomy enable us now to effect reduction in cases in which it was regarded as an absolute impossibility prior to their discovery. Division of the tendo Achillis in dislocation of the astragalus appears to have been first advocated and practised by Velpeau, Gerdy, and, in this country, by Mr. Campbell de Morgan: whilst cutting the tendons passing behind the ankle-joint to the foot was foreshadowed by Mr. Crosse, of Norwich, and advocated by Mr. Canton, who throws out a like suggestion in his "Surgical and Pathological Observations." The practice of dividing the tendo Achillis has been pursued in several instances with great success.

Case 1.—Samuel B—— was admitted into Guy's Hospital, under the care of Mr. Bryant, having fallen upon his right foot from a height of twelve feet, and obliquely fractured the right astragalus, and dislocated its upper articular surface forwards. The foot was much contused and injured; and in front of, and slightly below, the outer malleolus, was a projection, evidently of the astragalus, or rather of its superior surface. The superior and external articular facets were readily made out. Chloroform was administered, and the tendo Achillis divided; and Mr. Bryant, steadily pressing his thumb upon the displaced and fractured bone, after some little manipulation, returned it to its place without much difficulty. The limb was put up in splints, and recovery followed without a bad symptom. The man left the hospital in two months, with good movement of the joint.

Case 2.—A woman, aged sixty, was brought to the Middlesex Hospital from the country, in February, 1866, a few hours after having been thrown from a light cart, and was placed under the care of Mr. Moore. Her right foot had come to the ground with great violence, tearing her boot. The instep and outer ankle were largely swollen with extravasated blood, and in the swelling the head of the astragalus and its lower sharp outer edge could be felt. The inner side of the foot was concave and shortened. The prominence of the internal malleolus was lost, that process having sunk into the calcaneo-scaphoid socket, from which the astragalus had been dislodged. Attempts to reduce the bone were made at the time of the accident, and subsequently by a medical man in the neighbourhood. They were renewed by Mr. Moore after her admission to the hospital, when she had been placed under the influence of chloroform; but they all failed. Mr. Moore then, on the principle originated by Mr. De Morgan for the treatment of oblique fracture, divided the tendo Achillis, and returned the head of the bone to its socket on the scaphoid with moderate force.

Mr. Moore informs me that, to his knowledge, section of the tendo Achillis and division of the tibialis anticus were suggested as far back as the year 1850, in a case wherein the attempts to reduce the bone were unsuccessful. Unfortunately the suggestions were not adopted.

Mr. Crosse, of Norwich, in the year 1848, in a case of dislocation of the astragalus upwards and outwards, after unsuccessful attempts at reduction, divided the tendo Achillis, when the bone returned somewhat suddenly into its place, and the shape of the limb was restored.

MM. Thevenot and Lucien Boyer relate a case of complete dislocation of the astragalus inwards. In 1842, a drunken Lancer fell and dislocated the astragalus; the foot was turned in, and pointed forcibly downwards from contraction of the tendo Achillis. M. Thevenot divided the tendo Achillis, and reduced the dislocation. The patient recovered.

Mr. Turner, on the other hand, objects to division of the tendons in these cases, and even throws doubt upon the propriety of reducing complete simple dislocations of the astragalus at all. He says, "We must here revert to the observations which we made when speaking of reduction—namely, that the astragalus may be so isolated from its soft attachments from which the periosteum derives its vessels, as to render the death of the bone inevitable, in which case it would act as a foreign body, and more harm than good would result from its replacement. Secondly, if the tendons were cut through behind the ankles, they would be retracted in their sheaths so as to lose all attachment to the bones of the foot." Mr. Turner, in this paragraph, seems to me to have been inspired with the dread of evils for which there is little or no foundation. The records of surgery amply prove, what Mr. Turner also advances, that in many cases of dislocation forwards, inwards, and outwards, simple as well as compound, the bone has sloughed when allowed to remain unreduced; but as far as I have been able to discover of danger in reduction, it entirely disproves Mr. Turner's theory, as in no instance have I found reduction of complete simple dislocation of the astragalus followed by the misfortunes he has imagined; and, moreover, although he has himself given cases proving the converse proposition, he does not advance a single example to confirm his views.

So likewise in support of his objections to tenotomy, Mr. Turner quotes a case wherein the "late Mr. Wilson removed a part of the peroneus longus tendon, which was followed by shrinking and contraction of the *muscle to the full extent*, and consequently its use was lost." But it should be borne in mind that in these cases it is not proposed to remove any portion of tendon, but simply to cut it through, and that it does not necessarily follow that the section must be made behind the ankle, or within the sheath. Mr. Turner does not, however, so entirely object to division of the tendo Achillis in partial dislocation. He admits that it may in these cases be regarded as a means of facilitating reduction, and from this point of view justifiable.

But if we divide the various tendons, and still fail in reducing the bone, in what position do we place the patient? Can we still remove the bone? Can we safely leave it where it is, or must we proceed at once to amputation? These questions are best answered by the following valuable and interesting case recorded by Mr. Busk:—A man, aged forty-seven, came under his care on June 14th, 1850, with fracture of the lower third of the left leg and dislocation of the astragalus. On the next day, as there was great pain, and the limb could not be kept in position, Mr. Busk divided the tendo Achillis and the tendons of the tibialis anticus and extensor longus pollicis muscles. This diminished the deformity, but the astragalus could not be reduced. On June 17th the skin over the bone began to slough. July 1st: The slough was removed, exposing the anterior surface of the bone. 25th: As the discharge was fetid and the bone dark-coloured, Mr. Busk removed it. The patient in the following November could bear considerable weight on the limb.

On the other hand, many cases are related wherein the bone has been returned without any proceeding of the kind, and this should always be attempted in the first instance, since we see that tenotomy is not always successful, and it is obviously better not to divide the tendons unnecessarily.

Dr. Hoskins, of Sydney, New South Wales, had a case in which a young man, aged twenty-three years, jumped down three steps and fell, dislocating his left foot, turning it inwards and upwards, and displacing the astragalus forwards, without fracture either of the tibia or fibula. The knee being held by assistants, Dr. Hoskins forcibly depressed the front of the foot, at the same time pressing with his thumb on the bone, and making counter-pressure on the os calcis with the palms of his hands. He in this way returned the bone to its place.

Boyer relates the case of a farmer, aged thirty-eight, who on September 8th, 1848, fell from his horse, and dislocated the astragalus of his right foot. The foot maintained its normal position. The astragalus was turned over on its inner side, with its head lying immediately under the skin, which was powerfully stretched, smooth, polished, and discoloured. The external surface of the astragalus looked upwards, the inner malleolus resting upon it. Cold lotions were applied, opium given, the patient largely bled, and the next morning placed under the influence of chloroform, when M. Boyer made two assistants grasp the knee, and two others extend the foot. He then pushed the astragalus back into the gap thus obtained, and next placing his knee under the outer edge of the foot, he produced exaggerated adduction, at the same time pressing with all his might on the upper border of the astragalus with both his thumbs. This was completely successful; the displaced bone turned up, and resumed its wonted position with a loud crack. The shape of the foot became at once normal, and it could be moved without pain. No constitutional irritation followed; the swelling gradually subsided, and the patient recovered completely.

A man fell from a tree in 1788, and luxated his foot outwards and the astragalus forwards and upwards (a simple dislocation). Desault reduced the bone, and on the thirty-ninth day the patient left the hospital cured, able to walk without lameness.

Mr. Barwell has recently reduced a simple dislocation of the astralagus in a patient at the Charing Cross Hospital.

Mr. Turner contends that when, in addition to the approximation of the tibia and fibula to the os calcis, the astragalus is immovably fixed in its new situation, reduction is almost impossible; but when the bone is reversed in position, or thrown out of its natural axis, it is absolutely so. Boyer's remarkable case, which I have just related, would seem to be an exception to this general rule. By the table furnished by Mr. Turner, we find but six reductions out of forty-five complete dislocations of this bone. In complete compound dislocations of the astragalus alone, without fracture or solution of continuity and connexion in the bones and joints of the tarsus, he condemns all attempts at reduction as not only hopeless, but prejudicial; and says that extirpation should always be performed at once.

This question seems to me to remain open for further consideration. It is by no means so certain that opinions thus decidedly expressed by so high and so deservedly respected an authority may not have had their effect, and prevented surgeons making the effort. Undoubtedly mischief did sometimes accrue from torturing attempts at reduction, and a simple was sometimes in this way converted into a compound dislocation. Sir A. Cooper admits that in one case which he witnessed sloughing of the integuments was brought about by the continued extension and force used to reduce the bone. And Mr. Turner refers to a more recent instance, in which diffuse cellular inflammation, extensive suppuration, fascial sloughing, and death in all probability arose from reiterated violent efforts to reduce an irreducible dislocation.

We must all agree in deprecating hopeless endeavours or undue violence and perseverance in making attempts of any kind; but there is a wide difference between employing and improperly prolonging violent and injurious efforts and making no efforts at all. In the present day we possess in chloroform a powerful adjunct unknown to Sir A. Cooper and to the surgeons who practised within a very few years of the date of Mr. Turner's paper.

The question, after all, resolves itself into this: Is a patient who has suffered from either a simple or a compound dislocation of the astragalus in as good a position when that bone is returned to its natural situation as when it is removed altogether?

It would seem that in these accidents we have but three alternatives: to reduce the bone; to excise it; or to amputate the limb altogether. Save in dislocation backwards, we cannot safely leave the bone in its abnormal situation. It will in most cases require to be removed sooner or later. When dislocated forwards, inwards, or outwards, even though there be no wound in the skin, experience shows us that if allowed to remain unreduced the bone will in most instances die. On the other hand, in Boyer's case, notwithstanding the dislocation was complete and the bone thrown on to its side, a perfect cure resulted after the bone had been returned to its natural position; and the same result is stated to have attended the case of the late Mr. Ransome and others.

It very rarely occurs that the bone is so completely isolated that all its natural connexions with the soft parts are destroyed; and even when this does occur, I may, in this place, be forgiven for still recalling to remembrance and attaching great value to the lessons inculcated and the experiments related by Hunter in his great work upon Inflammation. I would, moreover, submit that there is no comparison between the condition of the bone when displaced and isolated, and that of the same bone when, having been so isolated and displaced, it is again restored to its natural situation. In the former instance, it is, so to speak, cast upon a barren rock; in the latter, it is returned to its native soil, where every appliance for its nutrition and reparation already awaits it.

In all cases of dislocation, therefore, whether simple or compound, partial or complete, I would make an attempt at reduction, especially when but little time has elapsed since the accident. I quite admit the unpromising condition of affairs when the tibia has come into perfect approximation with the os calcis. I also admit that in complete compound dislocation the case may wear a more serious aspect from the size of the cavity exposed; but this is, after all, a question of degree only. The cavity has been opened into, again and again, in compound fractures and dislocations of the ankle-joint, and yet the patients have done well. Still I would say that the attempt should be made. Everyone now knows how contracted muscles will yield under chloroform, and we have already seen how this yielding may be augmented by tenotomy; so that, with these adjuncts, the amount of violence required in the times to which Mr. Turner refers are now not only unnecessary but unjustifiable.

The two following cases in a great degree support the views here expressed:—

Mr. Burnett, of Winchester, was called to a Colonel G——, aged sixty, who, whilst hunting, met with an accident in which he sustained a compound dislocation of the astragalus and scaphoid bones. Mr. Burnett reduced the dislocation, and the patient got well.

Mr. Garland, of Liverpool, was called to a child aged four years, who had sustained a severe lacerated wound extending from the inner border of the arch of the right foot to its outer border. The os naviculare was dislocated upwards, and protruded through the wound, its attachments with the cuneiform bones being entirely separated, whilst the foot and leg were much contused. The child having been submitted to chloroform, Mr. Garland ascertained that no fracture had taken place. He therefore cleansed the wound and bone from foreign matter, and with considerable difficulty reduced the bone.

He then dressed the wound with wet lint, and placed the limb on an outside splint, with the knee flexed. The wound healed in six weeks, but for safety the child was made to wear a pad in the sole of the foot for another six weeks. When she left the hospital, the foot was slightly everted, and its arch less than that of the other foot, but she could make good use of it. A year afterwards she was seen running about the streets barefooted.

In some rare instances the position of the bone negatives all attempts at reduction. Dupuytren, Turner, and others, have found it completely turned over upon itself, so that its inferior surface had become its upper. In such cases as these, attempts at reduction would not only be useless, but obviously improper.

Excision of the astragalus may probably rank amongst the most ancient of the operations upon the foot. It is stated to have been performed for the first time by Fabricius, of Hilden, in the year 1582; and this tradition has been handed down from generation to generation to the present time. Nevertheless, the tradition is erroneous. Fabricius did not perform the operation at all. He merely narrated a case operated upon by another surgeon, whose name he neither had the candour nor the generosity to publish, and therefore carefully suppressed. That I may not be supposed to detract unfairly from his merit, I will allow him to speak for himself, in a report dated 11th November, 1608, addressed to "the most noble and learned man, Master Philibert Sarazen, the most renowned doctor of medicine at Lyons, the only friend of the great James Antonio Sarazen, by William Fabricius Hildanus:—

"The Reverend Master Woolfbrand, of Dusburg, a faithful and excellent minister of the divine word, a man conspicuous for piety, virtue and learning, of mature age, strong and fleshy, about the year 1582 (if I remember right), in the winter, when the ground was covered with ice, had been sent for to the next village to visit a sick person; and on his return, in jumping from a bank about three feet high, he so twisted and broke his right foot, that the whole of the os tali or astragalus, was not only displaced, but the ligaments by which it is bound to the other bones being broken, it burst through the skin under the internal malleolus, and hung out. When he was carried home, a surgeon was sent for, who, seeing that the bone was altogether separated, and only hanging by some fibres, cut it off, and applied medicaments to stop the bleeding. Shortly afterwards, those illustrious men, Master Galenus Wierus, and Master Cosmus Slotanus, my most honoured master, were called in. They prescribed low diet, evacuated bad humours from the body, let blood, and applied anodynes, and pus-moving remedies to the wound. They prevented the outburst of humours by repellants, or preventives, as they call them. The cure was difficult, painful, and long, although many friends, who were also learned men, were in attendance. For although the surgeon of Dusburg was highly esteemed in the profession, nevertheless sometimes John Wierus, sometimes Galenus Wierus, sometimes Solinander, all men of the greatest celebrity, and attendants of the Prince of Cleves, visited him, and prescribed all that they thought necessary. I also, together with the renowned Master Cosmus Slotanus, of Dusseldorf, often went to him. So, by Divine Providence alone, he at length so far recovered that he was even able to walk without a crutch, as I myself saw in the year 1599, when I was called in to that pious and honourable man, Master Simon Engelgraff, who was grievously bitten by a dog."

From this letter, we may rest assured that the first operation for the removal of the astragalus was performed by the surgeon of Dusburg, and not by Fabricius of Hilden. And we may feel equally certain that, for some reason or other, the name of the former was purposely suppressed. The operation remained in abeyance for a century and a half, when Broglie revived it in the year 1741. His example was followed by Aubray and Ferrand; by Marrigue, in 1782; and by Desault, in 1788, since which period it has become an established proceeding abroad. Stevens appears to have introduced the operation into America in the year 1826. Trye, of Gloucester, was the first to perform it in England, in the year 1789, upon a patient who had experienced compound dislocation of the bone. He was followed by Hey, of Leeds, in 1804; by Percy, in 1811; Evans, in 1815; the late Sir A. Cooper and Mr. Green, in 1820; and by the late Mr. Smith, of Leeds, in 1821. This latter highly distinguished surgeon excised the astragalus more frequently than any other surgeon in Europe, either past or present, although a quarter of a century elapsed between his fifth and sixth case. He, with a kindness for which I cannot feel too grateful, not only furnished me with the particulars of the ten cases which he performed, but also entrusted me with his valuable collection of preparations, &c., for the purpose of illustrating this lecture.

Since this period, the operation has become more generally established; so that I have been enabled to collect the particulars of 109 cases of *complete* excision of the bone performed by British and Foreign surgeons. Next to Mr. Smith, of Leeds, my colleague, Mr. Canton, has removed the astragalus most frequently. He has operated three times; Mr. Milner, of Manchester, twice; the late Mr. Statham, twice; M. Houghton, twice; Mr. Delagarde, of Exeter, twice; Mr. Garner of Stoke-upon-Trent, twice, and Mr. Timothy Holmes, twice. Many more surgeons have removed the bone once. They are too numerous for me to mention here; but their names are registered on the table before you.

To Mr. Busk is the honour due of applying this operation to disease. He removed the astragalus for caries in the year 1850 from a man aged forty-seven, and the patient did well. Up to the present time but three other cases have been recorded in England: one by Mr. Erichsen, one by Mr. Holmes, and the other by the late Mr. Statham.

Partial resection of the astragalus has, doubtless, been more frequently performed; but whether the cases have been unsatisfactory, or have not been considered of sufficient importance, there are by no means so many recorded. Many of my friends who have kindly furnished me with information, have remarked: "I frequently gouge away portions of the astragalus;" but they have not supplied me with details that I could register. I have been enabled, therefore, to collect but 10 cases of partial resection performed abroad; and but 17 cases operated upon by British surgeons—in all, 27.

Severin was the first who attempted to preserve a portion of the bone. He, in 1646, resected carious portions from the astragalus, &c., with a red-hot knife, and the patient recovered. In the year 1716 Goucy removed the lower end of the fibula three inches above the malleolus, which projected through the wound in a case of compound fracture. He subsequently removed a portion of the astragalus which had necrosed. Nevertheless, and in spite of other mischief, the patient recovered.

In England, Ramsey, in 1792, Batley, in 1797, Chorley, in 1805, Lynn, of Bury, Smith, of Leeds, Solly, Thorpe, of Manchester, Gaskell, of Manchester, Lowe, of Bristol, S. Hey, of Leeds, Addenbrooke, and Wakley, have all endeavoured to preserve a portion of the bone, and with varied success.

Of the 27 cases of partial resection, 13 were for compound fracture and dislocation, 1 for simple dislocation, 3 for simple dislocation and secondary caries, 8 for disease (caries); in 2 the cause was not stated.

Of those operated upon for compound fracture and dislocation, 12 had good results; 1 remained stiff and painful.

The patient upon whom partial resection was performed for simple dislocation underwent secondary amputation, and died.

Of the 3 for simple dislocation and secondary caries, all recovered completely.

Of the 8 for disease (caries), 5 terminated well; 1 terminated in anchylosis; in 2 the result was not stated.

Some very interesting points of practice remain to be noticed in connexion with excision of the astragalus—as to the cases in which it should be performed, the period at which it should be done, and the extent to which it should be carried.

Mr. Turner, and most other surgeons of experience, agree that in cases of simple fracture of the bone without displacement, and in all cases of partial dislocation, either simple or compound, we should trust to nature, and leave the bone alone, even though it cannot be returned to its natural position, as experience has shown that patients do very well under such circumstances. In complete compound dislocation, on the other hand, both Sir William Fergusson and Mr. Turner condemn the bone altogether, and advise its removal at once, without any effort being made to reduce it. Having already ventured to oppose this doctrine, I will content myself with expressing the opinion that, when it can be done without undue violence, the bone should always be reduced; for whilst we may even now be considered as being merely in the infancy of our knowledge in this department of surgery, the resources of nature are so vast that it almost seems like presumption to attempt to define a limit to them.

On the other hand, when the efforts at reduction have been made and failed, the bone should be removed without delay. The mode of doing this must depend upon the nature of the case. In some instances, as in the examples reported by Hildanus, Trye, and others, it is so completely isolated that a few strokes of the scalpel are all that is required. In other cases, again, it is so much entangled amongst the tendons that a more elaborate dissection is rendered necessary. Under any circumstances, the wound should be carefully cleansed of all extraneous matter, and the dressing so applied as to leave a depending opening where possible.

In complete simple dislocation of the astragalus surgeons are not so unanimous as to the course to be adopted. When dislocated completely backwards, as first described by the late Mr. Benjamin Phillips, it creates little disturbance, and interferes so little with the functions of the part, that all admit it should be left alone. Not so, however, when the displacement occurs in any other direction. In these the functions of the foot are so greatly impaired, if not entirely destroyed, by the presence of the bone in its abnormal situation, that the foot becomes almost useless. Sir Wm. Fergusson, it is true, has met with one example of unreduced dislocation of the astragalus forwards, which had occurred many years before; but the patient, an old soldier, was obliged to use a stick, and walk on the fore part of the sole of the foot, not being able to bring the heel to the ground. Mr. Wilson, of Manchester, also met with a case of unreduced dislocation outwards, which had occurred two years previously. The right foot was turned considerably inwards, so that it rested on the extreme outer side of the foot, the two points of contact, when resting on the ground, being the outer edges of the os calcis and the fifth metatarsal bone. The patient could not bear the slightest weight to rest upon the foot. A large projection was on the outer side of the dorsum of the foot. The integuments covering this projection were uninflamed; but on the slightest exertion redness and heat immediately ensued, and several times sores had formed on the skin. The leg was amputated, and the patient recovered.

Most surgeons agree that the bone in such cases, when irreducible, should be removed, but they differ as to the period when this removal should be effected. Some of the most eminent advocate immediate excision; others, equally eminent, advise that the bone should be allowed to remain until it has become detached by the natural process of separation, and then removed. On this point Mr. Turner sums up:—"In simple, direct, and complete dislocation of the astragalus, leave the bone alone until there is a tendency to inflammation and ulceration; then incise the skin over the bone to relieve tension and pressure, and when the bone is detached by the natural process of separation, remove it. The practical proceeding in complete and simple or simple and complicated dislocation will be determined by the position of the bone. If the protrusion be direct in reference to its axis, and cannot be reduced by moderate efforts, the case ought to be left to nature, because, although the chances are against its remaining passive, it will be well to await the event; and should the skin inflame, and other matters predicate the tendency to ulcerate through, it will be better to save the patient this source of irritation by an incision over the site of the astragalus, and leave the extrication of the bone to the efforts of nature, or, at all events, until it is so loose as to be easily extracted."

In simple indirect and complete dislocation, however, Mr. Turner advises an incision to be made at once over the bone, without waiting for untoward symptoms.

Whilst the idea of these incisions, with the view of preventing or removing tension and abridging the process of ulceration, originated with Mr. Turner, the remainder of the recommendation is grounded upon the experience of practice. In the year 1820 the late Sir A. Cooper was called to a case of complete simple dislocation of the astragalus which could not be reduced. He decided to leave the bone where it was, and to trust to the resources of nature. Great constitutional disturbance ensued; in a month the skin over the bone sloughed, and in three months the bone had become so loose and detached that he was enabled to remove it by forceps with the greatest ease.

The following case is very interesting from the advanced age of the patient.

J. F——, aged sixty-six, was thrown out of his cart, and admitted into the Leeds Infirmary on September 3rd, 1821, having received an injury to his ankle, supposed to be a fracture of the fibula. Mr. Smith saw the limb on the 7th, when there was a projecting part of bone in the situation of the head of the fibula, and a little lower another portion, both covered by integuments much upon the stretch. On the 15th the integuments had sloughed, and Mr. Smith now discovered the two projections of bone to consist of the astragalus. On October

6th, a month after the accident, Mr. Smith excised the bone without difficulty, and the patient was nearly well, when, having got wet, he caught cold, and an abscess formed in the part. He ultimately recovered, and, Mr. Smith informs me, lived to a great age, walking well and with only a slight limp.

J. K——, aged twenty-five, was admitted into the Leeds Infirmary October 25th, 1825, with supposed dislocation of the ankle-joint. In a few days a large slough formed below the ankle-joint, which, separating, the astragalus was found to have been displaced, its head being turned outwards. A month afterwards the astragalus, having become loose and carious, was removed, and the man recovered in two months.

J. B——, aged twenty-seven, a prisoner in the Wakefield House of Correction, whilst at work on the treadmill on August 3rd, 1830, slipped and was caught in the wheel. When extricated he could not stand. Mr. Dunn, the surgeon to the prison, recognising the injury, tried to reduce the bone, but failing, he sent the man to the Leeds Infirmary, where Mr. Smith made further attempts with pulleys, but without success. Mr. Smith therefore determined to allow the parts to remain in their present condition, in the expectation that the skin would slough and the displaced bone come away. The skin began to slough on the third day; but, even though the slough came away in due course and the bone was to a certain extent exposed, it still remained fixed; granulations covered its surface, and after four months of suffering and constitutional disturbance the sores healed. Three weeks after this, as the patient could not bear any weight upon the injured foot, Messrs. Chorley, Hey, and Smith determined to remove the bone, and, if this failed, to amputate the limb. Mr. Smith accordingly made a crucial incision over the bone, and endeavoured to draw it out by boring a gimlet into it, but unsuccessfully, owing to the softness of the bone, which bled profusely upon the removal of the gimlet. The operation proved very difficult, not only from the *strong connexions which had been formed between the astragalus and the contiguous bones, it being firmly anchylosed to them*, but likewise from the position of the bone, it being, as Mr. Smith graphically describes it, turned topsy turvy, its posterior part becoming anterior, and its inferior surface superior, the whole of its ligaments, &c., having been completely torn. The bone, however, was removed, and the foot immediately resumed its natural position. The patient was discharged cured on February 18th, 1831, between six and seven months after the accident.

This case is of great importance, from its proving that, even when completely isolated from its natural position, and exposed by sloughing of the integuments, the bone does not invariably die. And this is also to a certain extent proved by preparation

No. 9 of Mr. Smith's collection, taken from a tall and heavy gentleman, who, his horse having run away, leaped from his carriage on May 14th, 1864, dislocating his shoulder as well as his astragalus (simple, forwards, and inwards). The skin sloughed, the bone became loose, and Mr. Smith excised it on the 16th June following, rather more than a month afterwards. The limb did well, but the patient died in another month from large gangrenous bedsores over the sacrum. The bone does not appear to have undergone any alteration of structure.

Mr. Shillitoe, of Hitchin, has kindly furnished me with the following particulars of the case of a bricklayer's labourer who fell some sixty feet into a well, and dislocated his astragalus. He was at first treated at his own home for fracture, but as sloughing of the integuments took place, at the end of a month he was removed to the Hitchin Infirmary, where the nature of the accident was detected by Mr. Shillitoe, and by Mr. Carr Jackson, who happened to be present. Excision having been decided on, July 17th, 1865, a semilunar incision was made, and the bone seized with a pair of lion forceps, and removed. He had not a bad symptom, and on January 23rd, 1865, was well enough to bear slightly upon the foot. Through the kindness of Mr. Carr Jackson I am enabled to place the removed bone before you.

I am indebted to Dr. George Buchanan, Surgeon Glasgow Royal Infirmary, for the following very interesting case: "G.W., aged fifty-three, a gardener by trade, on the 23rd December, 1867, was involuntarily compelled to jump from a height on to a heap of stones, among which his left foot was forcibly twisted outwards. The surgeon who was called to see him judging that a fracture had taken place, put on gutta-percha splints and a starch bandage. In three weeks these were taken off, and a slough of two square inches was found over the inner ankle. In a fortnight the slough came away, leaving a surface of bone exposed. Since that time there had been no improvement; the bone remaining protruded. In May, 1868, he was admitted to the infirmary under my care. I found he had sustained a very unusual injury. The astragalus was dislocated backwards and turned perpendicularly and twisted round. The upper square articular surface was perpendicular, and turned inwards, and was protruding through the opening caused by the slough. The notched posterior border was resting downwards on the surface of the calcaneum behind the articular facet. The anterior end was resting against the *lower* articular end of the tibia. Since the accident the man had acquired some *slight* movement of the new articulation which had formed between the tibia on the one hand, and the astragalus and scaphoid on the other. For a fortnight various applications were made, but no attempt at granulation taking place, on the 22nd May I made two incisions, one perpendicular over the internal malleolus and the other horizontal along the foot, and tried to dislodge the bone from its new position. Finding it jammed in firmly between the tibia and os calcis I desisted, resolved that before I resorted to more extensive and powerful proceedings I would get permission to remove the foot if the next attempt should injure the soft parts too much. After some hesitation the man's employer induced him to submit to whatever I should deem requisite.

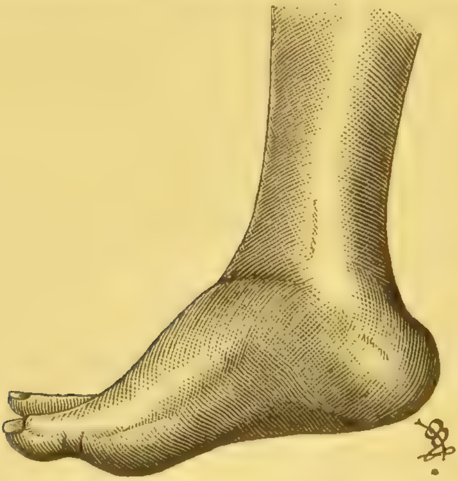
" On the 1st July I enlarged the opening through which the bone was visible, and by some powerful leverage I found I could shake the whole bone, which was completely necrosed. But it was so firmly wedged in that it could not be dislodged. I therefore split it with a pair of powerful bone forceps, and with a little leverage and traction pulled out each half separately. There was no hæmorrhage. The wound was filled with oiled lint.

" The following day granulations were visible all over the interior of the opening. The day after it was plain that the false ankle between the tibia and the scaphoid and new tissue, admitted of pretty free motion.

" 6th.—Wound rapidly filling up, and general swelling altogether fallen."

Other surgeons, on the contrary, prefer the immediate removal of the bone in complete and simple dislocation of the astragalus, whether direct or otherwise, alleging that thereby they prevent the pain and irritation resulting from the bone acting as a foreign body, and the consequent tension and sloughing of integument.

In two cases my colleague, Mr. Canton, pursued this practice with excellent results. A tailor, aged forty, dislocated his right astragalus forwards and outwards, and was brought to the Charing Cross Hospital. His foot, inverted, rested on its outer side; the outer malleolus was very prominent, and the skin extremely tense. Immediately in front, and on the same level, was a hard, smooth, rounded projecting surface, resting on the junction of the os calcis with the cuboid. This was the head of the astragalus, the upper surface of which bone could be distinctly felt internal to, and beneath, the external malleolus. The internal malleolus could not be distinguished from the swelling; the arch of the foot was partially lost, the length of the heel diminished. Mr. Canton made a horse-shoe incision over the external malleolus and head of the bone, cut through the ligamentous attachments, and detached it. The case terminated satisfactorily, and the patient is now able to walk well.



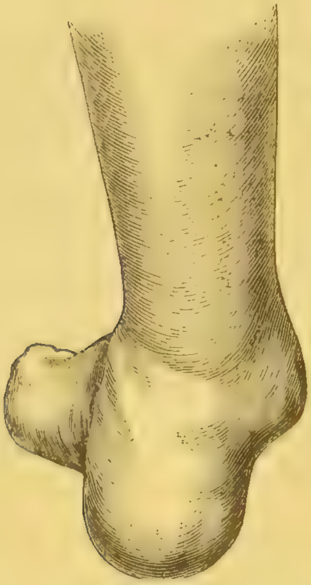
The annexed woodcut represents the foot of one of Mr. Canton's patients after operation.

The following case is important as illustrating the benefit resulting from the employment of the carbolic acid dressing.

J. H., a carpenter, aged forty-seven, a strong healthy man, was admitted under my care on 18th September, 1871, with dislocation of the astragalus of his right foot forwards and outwards, he having fallen from a pair of steps and twisted his foot inwards as he alighted on the ground.

The bone was twisted upside down, and was fractured at its lower part. There was no wound, but the skin was stretched so tightly over the displaced bone as to threaten gangrene. Under these circumstances I at once cut down upon the bone, and removed it without difficulty. The wound was brought accurately together, and covered with a pad of lint soaked in a solution of carbolic acid, 1 in 60, and the limb placed on a back splint with a foot-piece, and swung in a Salter's cradle, the wound being constantly kept moist with carbolic acid solution by means of a bottle syphon attached to the cradle. The first dressings were not removed until November 13th, eight weeks after the operation, when the wound was found completely filled up, the only trace of the operation being a narrow line of exuberant granulations. He slept well after the operation, and his appetite was good throughout. At the expiration of another month he could bear the weight of his body on that foot, and walk well with the aid of a high-heeled boot.

The following woodcut is taken from a case of partial dislocation of the astragalus, in which Dr. Hulme, of Dunedin, excised the astragalus.



The patient recovered with free motion in the joint.

When the astragalus is completely dislocated, or in cases of compound dislocation of the bone complicated with fracture, if the fracture involves the body of the astragalus, it is better, if we operate at all, to remove the whole of the bone, and not to leave any portion behind. It is true, as in the two following cases, that the contrary practice frequently proves successful; but when it fails, the consequences are so serious that, as a general rule, it is better not to risk it.

Mr. Gaskell, of Lancaster, informed Mr. Turner of a case under the care of Mr. Golland. The astragalus was split into two portions; the external and smaller escaped, and the other piece remained between the tibia and calcis. Mr. Golland removed this portion, with the lower end of the fibula, and the patient recovered the use of the limb.

Mr. Holmes, on December 19th, 1862, removed the body of the astragalus for necrosis following dislocation and fracture, from a man, aged forty-nine, leaving the head of the bone attached to the scaphoid. The patient recovered in three months with a useful foot, and the perfect power of walking.

Dr. W. Mac Cormac has kindly allowed me to have the two following woodcuts copied from his valuable paper in the *Dublin Quarterly Journal of Medical Science* for May, 1871. They were taken from the annexed case of compound and complete dislocation of the body of the astragalus outwards, complicated with fracture of the neck of the bone, the head remaining *in sitû.*

J. H.——, aged forty-six, April 9, 1866, was driving a young horse, which suddenly becoming unmanageable, the driver was thrown on the road-side, falling on the top of some logs of timber. The fore part of the foot got wedged between two of the logs, the patient at the same time falling on his left side, and his weight being thus exerted at the end of a long lever, with irresistible force, the ankle was dislocated outwards, and the foot inwards.

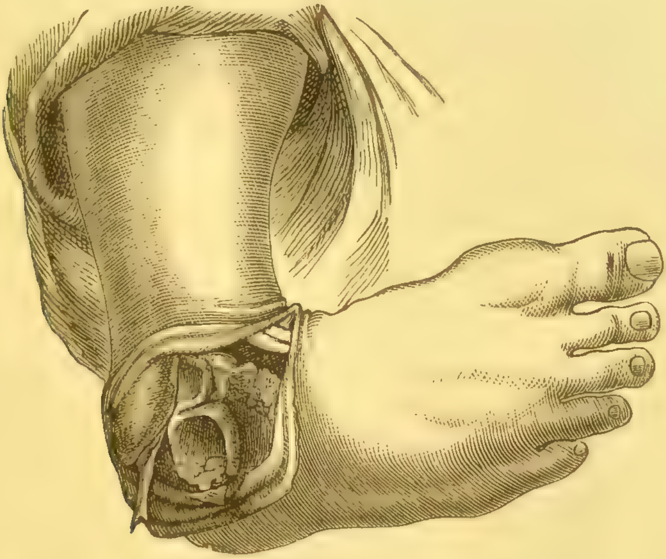
"Dr. Mac Cormac found a wound nearly four inches long and two and a half inches wide, extending across the outer malleolus from the instep to the tendo Achillis. The edges of the wound were tense and contused, and devaricated by the displaced astragalus, which partially protruded. The foot was forcibly everted and adducted, and inclined at somewhat less than a right angle to the axis of the leg; so that, supposing the patient erect, the outer border of the foot would rest upon the ground, and the toes be directed towards the opposite instep. The internal malleolus was entirely hidden, its usual situation being occupied by a deep sulcus, beneath which the inner portion of the heel formed a marked projection.

"In the wound on the outer side, the most prominent object was the large articulating facet of the astragalus with the os calcis. The posterior margin of this facet was fractured by the forcible rotation of the astragalus, which had also caused the bone to give way at its weakest part, the neck.

"The margins of the trochlea, and of the external articulating surface of the astragalus, were also partially visible. In the superior and posterior part of the wound, the extremity of the fibula was bared, and hanging loose from it was the middle fasciculus of the external lateral ligament; which had dragged along with it the portion of the os calcis, to which it is attached.

"In the anterior angle of the wound the extensor tendons were seen exposed, whilst behind and beneath the peronei tendons were stretched tensely across it.

"Neither the tibia nor fibula were broken at any point."

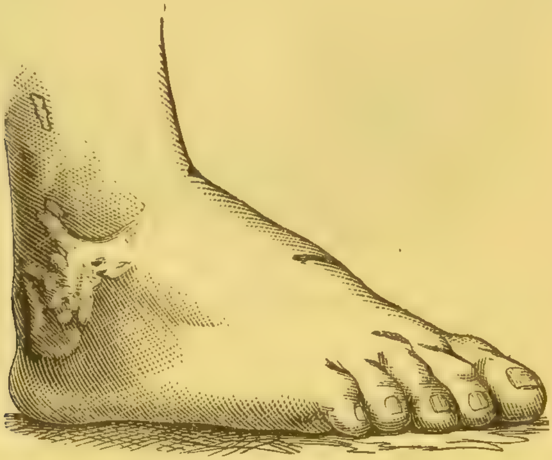


Dr. Mac Cormac removed the body of the astragalus, but allowed the head of the bone to remain undisturbed in its articulation with the scaphoid. The foot, on being replaced, was drawn up forcibly by the muscles of the leg against the under surface of the tibia. No vessel required ligature. Strips of wet lint were applied around the injured joint and the limb put up in Cline's splints, and on the day after the operation it was suspended in a swing splint.

The man was discharged from the hospital in good health, on the 27th July, 109 days after the accident. The original wound had contracted to the size of a sixpenny piece. On the inner side was a granulating surface 1½ inches long by ½ an inch wide. The foot and ankle were still swollen, and the former is firmly anchylosed to the leg.

Dr. Mac Cormac saw his patient eleven months after the accident. The wounds were quite healed, the swelling of the limb had subsided, and there was neither pain nor uneasiness in it. The patient could go about without even the assistance of a stick, and with only a slight halt.

The annexed woodcut represents the appearance of the foot.



Isaac B——, aged twenty-two, suffered compound dislocation and fracture of the astragalus on the 7th of April, 1826. When admitted into the Leeds Infirmary, there was considerable inflammation, and a small wound near the ankle. In three months Mr. Smith enlarged the wound, and removed the portion of the astragalus now before you (No. 4). Considerable sloughing ensued, and when he left the infirmary, between six and seven months afterwards, his foot was almost useless from stiffness and pain when placed on the ground. Mr. Smith writes me word, that if he now had to treat the case, he would certainly remove the whole of the bone.

Norris, of Pennsylvania, relates a case of simple fracture and dislocation of the astragalus in a man aged thirty. He cut down and took away all but a portion of the pulley surface, which was left behind in the mortice, on the 26th of September, 1837. Abscess, &c. took place, and on the 27th of March, 1838, amputation of the limb was performed, followed by death on the 5th of April.

Mr. Sampson, of Southampton, has favoured me with the particulars of a case of compound dislocation of the astragalus in an elderly man. A portion of the bone was sawn off, and the remainder replaced. The limb had afterwards to be amputated for extension of mischief. The case ended fatally from secondary hæmorrhage, and ossification of the tibial arteries was found after death.

J. M., aged thirty-seven, was admitted into the Leeds Infirmary, on the 14th of November, 1859, with compound dislocation and fracture of the astragalus. Mr. Smith removed the larger portion at once, and the patient became an out-patient on the 20th of February, 1860. On the 14th of March he was obliged to be readmitted for the removal of the small portion of bone which you can see in preparation No. 6. He again became an out-patient on the 26th of April, and Mr. Smith informs me that, on the 7th of May, 1862, he saw the man, who could then walk with a very little limp, and with a fair hinge-joint at the ankle.

On the other hand, John N——, aged thirty-six, on the 21st of December, 1865, fell down a well, and alighted on a roller, experiencing a compound dislocation of the astragalus outwards, with a small portion broken off. Mr. Smith, of Leeds, removed the bone the same evening, together with the fragment. Mr. Smith writes me: "The cast of John N——'s leg was taken before he left the infirmary, when the wound was not quite healed, and the swelling not gone down. He has just called on me by request of Mr. Wheelhouse. He is quite well; the wound entirely healed two or three weeks ago. He walks with a stick, but does very well without it when at home, and wears a boot, the heel of which is not half an inch thicker than the one on the sound side."

Results.—When the bone is completely removed, the patient commonly, as we have seen, recovers, with considerable motion in the ankle-joint, now formed between the lower end of the tibia on the one hand, and the os calcis and the scaphoid on the other. In other instances, as in that illustrated by a diagram in Mr. Turner's paper, the horizontal portion of the tibia corresponds to the scaphoid, whilst the internal malleolus occupies the interval between the sustentaculum tali and the scaphoid. The posterior astragaloid surface on the os calcis is not occupied, so that the weight of the body is referred to the anterior articulating surface on the calcis, and to the scaphoid. In a case related by Mr. Wilson, of Manchester, the astragalus was not entirely removed, the anterior portion having been allowed to remain. The remnant of astragalus interposed between the tibia and scaphoid prevented the descent of the former upon the latter. The tibia consequently rested by its malleolar process upon the posterior astragaloid surface of the os calcis; and being anchylosed to the os calcis below, and to the remnant of astragalus in front, the latter, in its turn, being similarly joined to the os calcis and scaphoid, the motions of the joint were entirely destroyed.

M. Thierry examined a foot of a patient who died of another complaint some time after the operation, in which the whole of the bone had been removed, save its head and neck. The articular surface of the tibia was in contact with the remains of the astragalus, and united by fibrous tissue. The malleoli remained unchanged, except that they descended more than usual.

Hence, as Boyer asserts, anchylosis is not a necessary consequence. On the other hand, Heyfelder states, that of sixty-seven cases, he only found ten in which the mobility of the foot, or even the formation of a new articulation, was established and expressly named.

As to the effect of these accidents upon the ligaments and tendons. A man aged sixty jumped out of a window, and dislocated the astragalus of the right foot. The bone could not be reduced, and as gangrene threatened, the limb was amputated three weeks afterwards by the late Mr. Ward. Dissection showed the bone displaced obliquely downwards, forwards, and outwards, so that the head, neck, and more than the anterior third of the body formed a prominent tumour on the upper, outer, and back part of the tarsus. The anterior ligament of the ankle-joint, the middle fasciculus of the external lateral ligament, as well as the interosseous ligament, were ruptured. The peronei muscles, displaced a quarter of an inch inwards, were rendered tense, as were the tibialis anticus and extensors, whilst the tibialis posticus and flexors were relaxed.

Results of the operation of complete excision of the astragalus, performed by British surgeons.—I have collected 57 cases. Of these, 33 were compound dislocations, of which 5 were complicated with fracture; 12 were simple dislocations; and 3 caries.

Of the 33 operations performed for compound dislocation, in 24 the patients recovered with good, useful limbs; 1 underwent secondary amputation of the leg, and recovered; 8 died, of whom 1 had undergone secondary amputation.

Of the 12 operations performed for simple dislocation, in 9 the patients recovered with good and useful limbs; of these 12, in 4 patients, of whom 1 died, the bone was allowed to remain for a month; in 1 it was allowed to remain nineteen weeks; in 4, of whom 2 died, the bone was removed immediately.

Of the 3 operations performed for disease, in 2 the patients recovered with good and useful limbs; 1 recovered for a time, but the disease returned in two years, necessitating amputation of the leg, the patient, however, doing ultimately well.

In 3 instances the cause is not given. Of these, 1 patient died, and 2 recovered.

If to these we add 52 operations performed by surgeons abroad, we get a total of 109.

Of these, 64 were for compound dislocations, of which 5 were complicated with fracture; 4 were for compound fractures; 20 for simple dislocations; 10 for disease (caries); 1 was for necrosis; of 10 the causes are not stated.

Of the 64 excisions performed for compound dislocation, in 50 the patients recovered with good and useful limbs; 1 underwent secondary amputation of the leg, and recovered; 11 died, of whom 1 had undergone secondary amputation; of 2 the results are not given.

Of the 4 cases operated upon for compound fracture, in 3 instances the patient recovered with good and useful limbs; 1 died.

Of the 20 patients operated upon for simple dislocation, in 4, of whom 1 died, the bone was allowed to remain for a month; in 1 the bone remained for nineteen weeks; in 7, of whom 2 died, the bone was removed immediately; in 2 the bone was removed for secondary caries, but at what period it is not stated. In the remaining 6 the period of removal is not given.

Of these 20, 14 recovered with good and useful limbs; 3 died; in 3 the results are doubtful.

Of the 10 operations performed for disease (caries), in 6 the patients recovered with good and useful limbs; 1 submitted to secondary amputation two years afterwards, and recovered; 1 died; in 2 the results are doubtful.

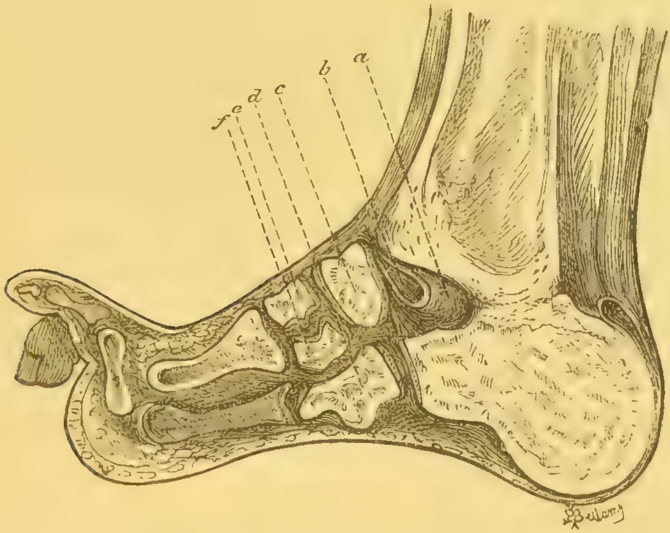
The patient operated upon for necrosis did well.

Of the 10 cases the causes of which are unknown, 2 patients recovered with good and useful limbs; 1 died; in 7 the results are not known.

So that of the 109 cases, 76 were recoveries with good and useful limbs; 2 patients submitted to secondary amputation, 1 recovered; 16 died, including 1 in which secondary amputation had been performed; in 14 the results are not known.

In June, 1872, the patient operated upon by Mr. Canton, and whose case is related at page 250, died at the Charing-cross Hospital from an attack of paralysis. Mr. Bellamy dissected the foot, and has kindly furnished me with the annexed account of the dissection, as well as with the drawing from which the accompanying woodcut has been engraved.

Before the skin was reflected the appearance of the foot was nearly normal, the natural curves being almost as perfect as though the astragalus was present. No cicatrix was visible. On removing the integument, the tendons in front and behind the newly-formed ankle-joint were found to have formed attachments to the walls of the original canals or sheaths in which they ran, especially on the peroneal aspect of the joint. The tibia and fibula were found to be jammed down upon the os calcis, and the normal mutual relation of the inferior articular extremities of these bones altered to allow of the newly-formed bearing-point, with which they had become associated, they being set more obliquely.



(*a*) Strong band of fibrous tissue thrown out between tibia and os calcis.
(*b*) Synovial membrane between tibia and scaphoid bone.
(*c*) Scaphoid bone.
(*d*) Cuboid bone.
(*e*) Middle cuneiform bone.
(*f*) External cuneiform bone.

The section is made through the second toe.

The scaphoid had formed an articulation with the anterior margin of the inferior articular extremity of the tibia, and the cuboid was found to be thrust under the scaphoid more towards the middle plane of the foot than normal. The articulation between the scaphoid and cuneiform bones was perfect, but it seemed that the natural relations of the cuneiform bones were altered, their normal arch having a higher pitch.

On making a longitudinal section of the foot vertically through the tibia, os calcis, and second toe, the great perfection of the natural arch and its several bearing-points was very remarkable. The newly-formed union between the inferior articular extremity of the tibia and the upper surface of the os calcis was very firm, and a distinct cartilaginous layer was found. The interspace between the upper anterior portion of the os calcis, under surface of scaphoid and front of tibia, was found to be filled in with tough fibrous tissue, and a large synovial membrane, evidently forming a joint possessed of extensive motion. The rest of the articulations appeared normal in structure, though somewhat altered in position.

TABLE OF CASES OF COMPLETE EXCISION OF THE ASTRAGALUS BY BRITISH AND FOREIGN SURGEONS.

No.	SURGEONS. *British.*	Date.	Disease.	Sex.	Age.	Life	Results. Use of Limb.
1	Trye, Gloucester	1789	Comp. disl.	F.	54	..	Good.
2	Hey, Leeds	1804	„	..	..	D.	
3	Percy	1811	.. ..	..	..	..	
4	Evans	1815	Comp. disl.	..	..	..	Good.
5	Green	1820	„	M.	20	..	„
6	Sir A. Cooper	1820	1 month after simp. disl.	..	..	..	„
7	West	..	Comp. disl.	..	..	..	„
8	Downes	..	„	..	..	..	„
9	Hammond, Southgate ..	..	„	M.	..	..	„
10	Norwood	..	„	..	..	..	Amputation.
11	Smith, Leeds	1821	Simp. dis. secondy. caries	M.	66	..	Good.
12	„ „	1821	Comp. disl.	M.	..	D.	
13	„ „	1825	Simp. disl.	M.	25	..	Good.
14	„ „	1830	„	M.	27	..	„
15	„ „	..	„	M.	..	..	
16	„ „	1855	.. ..	M.	52	D.	
17	„ „	1855	Simp. disl.	M.	52	..	Good.
18	„ „	1864	Simp. dis. secondy. caries	M.	..	D.	
19	„ „	1865	Comp. disl.	M.	36	..	Doing well.
20	Arnott	1830	„	..	..	..	Good.
21	Liston	1836	„	M.	18	D.	
22	Calloway	1839	„	M.	48	D.	
23	T. Milner, Manchester	1841	„	..	..	..	Good.
24	„ „	..	Simp. disl.	M.	..	D.	
25	Wilson, Manchester ..	1841	„	M.	..	..	Good.
26	Turner, Manchester ..	1841	Comp. disl.	M.	32	..	„
27	Smart	1844	„	..	..	D.	
28	Kittner	..	„	..	..	..	Good.
29	Shaw	1845	Simp. disl.	M.	..	..	„
30	Solly	1845	Comp. disl.	M.	..	D.	Amputation.
31	Lawrence	1848	Simp. disl.	F.	..	..	
32	Moore	1848	Comp. fract. and disl.	M.	22	..	Good.
33	Busk	1850	Caries ..	M.	47	..	„
34	Golland, Manchester ..	1850	Comp. disl.	M.	..	..	„
35	Statham	1852	Caries ..	M.	5	..	„
36	„	1855	„ ..	M.	49	..	Doubtful.
37	Turner, Stafford	1853	Comp. disl.	M.	15	..	Good.
38	Robertson	1854	„	M.	44	..	„
39	Haughton	1855	Comp. disl. and fract.	M.	14	..	„
40	„	1855	Comp. disl.	M.	14	..	„
41	Williams	1855	Simp. disl.	M.	54	..	„
42	Ball, Stafford	1858	Comp. fract.	M.	46	..	„

No.	Surgeons. *British.*	Date.	Disease.	Sex.	Age.	Life	Results. Use of Limb.
43	Canton	1858	Comp. fract.	M.	..	D.	
44	„	1864	„	M.	40	..	Good.
45	„	1865	„	M.	..	..	„
46	Teale, Leeds	1859	Comp. disl.	M.	34	D.	
47	Erichsen	1859	Caries ..	F.	8	..	Good.
48	Gisborne, Derby	1859	Comp. disl.	M.	37	..	„
49	Bryant	1859	„	M.	50	..	„
50	Tudor, Dorchester ..	..	.. ..	..	..	..	
51	Garner, Stoke	..	.. ..	..	..	..	Good.
52	„ „	..	.. ..	..	..	D.	
53	Delagarde, Exeter ..	..	Comp. disl.	..	..	..	Good.
54	„ „	..	„	..	..	..	
55	Holmes	1862	Necrosis ..	M.	49	..	Good.
56	„	1866	Caries ..	F.	$2\frac{3}{4}$	..	„
57	Shillitoe, Hitchin	1865	„ ..	M.	..	..	„
58	Griffith, Wrexham ..	1866	Accident ..	M.	40	D.	Tetanus.
59	„ „ ..	1866	„ ..	M.	20	..	Good.
60	„ „ ..	1866	„ ..	M.	63	..	„
61	Canton	1867	Dislocation	M.	..	..	„
62	Hulme	1867	„	M.	..	..	„
63	Buchanan, Glasgow ..	1868	Necrosis ..	M.	53	..	„
64	Hancock	1871	Dislocation	M.	47	..	„
	Foreign.						
1	Hildanus (reported by)	1582	Comp. disl.	..	..	..	Good.
2	Broglie	1741	„	..	..	..	„
3	Aubray	..	„	..	..	..	„
4	Ferrand	..	„	..	..	..	„
5	Marrigue	1782	„	..	..	..	„
6	Desault	1788	„	..	..	..	„
7	„	..	„	..	..	..	„
8	„	..	„	..	..	..	„
9	„	..	„	..	..	..	„
10	„	..	„	..	..	D.	
11	Mauduyt	1791	„	..	..	..	Good.
12	Laumonier	1792	„	..	..	..	„
13	Daniel	1812	„	..	..	..	„
14	Dupuytren	1816	Simp. disl.	M.	..	..	„
15	Roux	1817	Comp. disl.	..	..	..	„
16	Dupuytren	1819	„	F.	..	..	„
17	„	..	„	..	..	..	„
18	„	..	„	..	..	..	„
19	Barbierre	1821	„	..	..	..	„
20	Modesti	1821	Simp. disl.	M.	30	..	„
21	Larrey	..	.. ..	..	..	..	
22	Dufaur	..	.. ..	..	..	..	
23	Fallot	1828	Comp. disl.	M.	..	..	Good.
24	Dassit	1825	„	M.	45	D.	
25	Champion	..	Caries ..	..	..	..	Good.
26	Stevens, America	1826	„ ..	M.	..	..	„
27	J. Cloquet	1830	Comp. disl.	M.	46	D.	
28	Dr. Gillespie, America	1833	Simp. disl.	F.	50	..	Good.
29	Hesselbach, jun.	..	Comp. disl.	..	..	..	Doubtful.

No.	Surgeons. *Foreign.*	Date.	Disease.	Sex.	Age.	Life	Results. Use of Limb.
30	Thierry	..	Comp. disl.	..	..	..	Good.
31	Heidenreich	1840	”	..	..	..	”
32	Hinterberger	1841	”	..	..	..	”
33	Rognetta	1842	”	M.	50	..	”
34	Dietz	1842	Caries	..	..	..	”
35	Onstalet	1843	Comp. disl.	..	..	D.	
36	Velpeau	1843	”	M.	50	D.	
37	”	..	”	..	..	..	Good.
38	Robert	1846	”	..	..	..	”
39	Chabanon	1850	”	..	..	..	”
40	Thore	1850	”	..	..	..	Doubtful.
41	Letenneur	1850	”	..	..	..	”
42	”	1852	”	..	..	..	Good.
43	Thore	1851	Simp. disl.	M.	..	..	”
44	Estevenet	1854	”	..	..	..	”
45	Williams, America	1855	.. ..	M.	54	..	”
46	J. F. Heyfelder	1859	Simp. disl.	F.	14	..	Doubtful.
47	O. Heyfelder	1859	”	M.	30	..	Good.
48	”	1859	Caries	F.	14	D.	

TABLE OF CASES OF PARTIAL EXCISION OF THE ASTRAGALUS BY BRITISH AND FOREIGN SURGEONS.

No.	SURGEONS. *British.*	Date.	Disease.	Sex.	Age.	Life	Results. Use of Limb.
1	Ramsay	1792	Comp. fract.	M.	40	..	Good.
2	Batley	1797	,,	M.	..	..	,,
3	Chorley	1805	,,	M.	..	..	,,
4	Lynn, Bury	..	,,	M.	32	..	,,
5	Sawyer	1825	Simp. dis. secondy.caries	M.	22	..	,,
6	Smith, Leeds	1826	Comp. fract. and disl.	M.	25	..	Stiff, painful.
7	B. Cooper	..	,,	M.	..	..	
8	Thorpe, Manchester	1840	Simp. disl.	M.	..	..	Good.
9	Spry	1847	Comp. fract. and disl.	M.	22	..	,,
10	Faircloth	1848	,,	M.	14	..	,,
11	Lowe, Bristol	1850	,,	..	..	..	,,
12	Gaskell, Manchester	1850	,,	M.	40	..	,,
13	Wakley	1850	Caries	F.	23	..	Anchylosis.
14	Solly	1854	,,	..	..	..	
15	Hancock	1854	Simp. dis. secondy.caries	M.	32	..	Good.
16	S. Hey, Leeds	1856	Comp. fract. and disl.	..	..	..	,,
17	Addenbroke	1856	Caries	F.	4	..	,,
18	MacCormac	1866	Comp. fract. and disl.	M.	46	..	,,
19	G. Buchanan, Glasgow	1867	Caries	..	..	..	,,
	Foreign.						
1	Severin	1646	Caries	M.	..	..	Good.
2	Goucy	1716	,,	M.	..	..	,,
3	Aubray	1771	..	..	..	..	
4	Moreau, jun.	1796	Caries	..	..	..	
5	Duverney	..	..	..	..	..	
6	Champion	..	Caries	..	..	..	
7	Stephens, New York	1827	Comp. fract. and disl.	M.	..	..	Good.
8	Norris, Pennsylvania	1837	Simp. fract. and disl.	M.	30	D.	Amputated.
9	Oliver, Boston, U.S.	1858	Comp. fract. and disl.	M.	30	..	,,

LECTURE VII.

ON EXCISION OF THE ANKLE-JOINT.

MR. PRESIDENT AND GENTLEMEN,

Whether considered in relation to the importance of the region in which it is performed, or the amount of benefit it is destined to afford, excision of the ankle-joint has not met with that support to which it is fairly entitled. Whilst in England the shoulder, elbow, hip, knee, and other joints are freely excised, and, when offering a prospect of success, a surgeon would almost be considered as deserving of censure who would neglect these operations for amputation, excision of the ankle-joint has for the most part been regarded with disfavour.

Why, in this age of conservative surgery and joint resection, a solitary exception should be made in the case of the ankle-joint, and so valuable a member as the foot needlessly sacrificed, is an anomaly which I confess I do not understand. We have seen in Syme's operation that, independently of the entire loss of the foot, there is danger of sloughing of the flaps, of bagging of matter, and in both

Syme's and Pirogoff's of inflammation, suppuration, and sloughing in the course of the divided tendons. In excision of the ankle-joint these dangers do not exist. I have now performed this operation five times—four times successfully, once unsuccessfully, the patient dying some six months after the operation from lung disease, the result of a life of dissipation. In no instance has there been sloughing. There need not be a single tendon or artery divided. There is afterwards very little deformity—comparatively little shortening; the foot is preserved; and, as we shall see, the patients are able to walk and run with perfect ease. Surely an operation presenting so many advantages should not be lightly cast aside, nor condemned by theoretical objections without a trial. But so little consideration has there been given to the matter, that in England, even in these days of conservative or pathological surgery, as many as thirty-four legs were amputated in one year for disease reported to have been restricted to the ankle-joint, without even the improvements afforded by Syme's or Pirogoff's methods having ever been attempted. We may partly attribute this to the confused ideas entertained as to the exact nature of the operation by authors who write upon that which they have never done, and which they do not understand, and who consequently mislead their readers by inexactness of detail, and by the heterogeneous mass of discordant cases which they have collected and described under the head of "Excision of the Ankle-joint," and which in reality have as little to do with this operation as they have with Syme's or Pirogoff's amputation.

A recent American author, professing to write upon excision of joints, includes the following operations in his table and description of excision of the ankle—viz., excision of the astragalus and os calcis; removal of the end of the tibia; removal of the end of the fibula; removal of the ends of the tibia and fibula, with the astragalus and navicular bone; simple excision of the astragalus; of the ends of the tibia and fibula, with the whole of the astragalus, part of the os calcis, and the three cuneiform bones; of the end of the tibia, with the astragalus, scaphoid, and two cuneiform bones; excision of the astragalus and scaphoid; excision of the os calcis, astragalus, and cuboid.

Although Hippocrates is stated to have removed the lower ends of the tibia and fibula for compound dislocation, Mr. Hey, of Leeds, performed the first authenticated operation of the kind as early as the year 1766; but it was not until the year 1792, that the elder Moreau performed excision of the ankle-joint for disease, being the first occasion upon which this operation had been performed excepting for accident.

The case was that of the son of M. Lucot, inspector of gendarmerie, who met with a sprain in the year 1791, which ended in extensive caries of the left ankle. After the lapse of a year there was a fistulous ulcer on each side of the joint, discharging sanious and fœtid pus; and the probe being introduced through the openings, the articulating surfaces of the tibia and fibula, as well as the body of the astragalus, were felt to be bare. The foot and the lower part of the leg were swollen, and the patient could not bear his weight on the limb. On the 15th of April, 1792, Moreau excised the ankle-joint, removing the lower ends of the tibia and fibula, and the whole of the upper articulating surface of the astragalus, and a great portion of its body, till he came down to what was sound. In six months the patient was able to bear his weight upon the foot. During the seventh month he used crutches; in the eighth he could walk with a stick; and by the end of the ninth he walked without any assistance whatever, and in such a way that he could do as he pleased.

It is interesting to read the description given by Moreau's son of the disfavour shown by the French surgeons, not only to this operation, but to resection of joints in general. In the year 1784 Mr. Park's observations on cutting out the articulating ends of the bones of the elbow and knee joints were translated and published in France by Professor Lassas, whose authority, observes Moreau, "one would have thought might have procured for them a favourable reception. They were received with astonishment; and so far were they from gaining credit, that in 1789 they had acquired so few supporters in the Academy of Surgery that some cases of a similar kind, presented to the Academy by the elder Moreau, were rejected, though they were of such a nature, and stated in a way that deserved a more favourable reception." Nothing daunted, Moreau again addressed the Academy of Surgery, supporting his memoir by many facts. His essay, however, met with the most violent opposition. The Academy, as is too often the case, found it more convenient to deny than to examine these facts; and, instead of taking the trouble to ascertain their reality, they answered in a way that forbade all future inquiry upon matters demanding the greatest attention. It is due to M. Pellaten to state that of all the then members of the Academy he alone appears to have considered the subject worthy of attention.

The second operation on record was performed by Moreau, junr., in 1796. He preserved the lower end of the fibula, and consequently had great trouble in getting away the diseased parts, being obliged to use the gouge freely. The recovery was not so satisfactory as could have been desired.

The third operation was by Mulder in 1810. He at the same time removed five inches of the fibula.

In 1813 Champion is reported to have operated upon a woman, who afterwards frequently walked three leagues to be examined by Roux and others.

In England there was no example on record of excision of the ankle-joint prior to February, 1851, when I performed the operation for the first time. Attempts have been made to deprive me of the merit of its introduction to British surgery, but I contend that if the term "excision of the ankle-joint" means the excision of those parts only which enter into the formation of the joint, the credit is my own; but if, on the contrary, it means the removal of any amount of the foot, whether comprehended in the joint or not, that the credit is more justly due to Liston, Wakley, Teale, and others.

The author of the work already alluded to says: "It does not appear, however, that after the above cases (those by the Moreaus) this operation was again attempted for disease until 1818, when it was undertaken by Mr. Liston, in Edinburgh. In April, 1830, it was performed in France by M. L. Champion, and in June of the same year by M. Roux. In December, 1847, Mr. Thomas Wakley excised the os calcis and astragalus; and in March, 1850, the end of the fibula, with part of the astragalus. It appears, therefore, that the honour of first performing this operation in Great Britain belongs to Mr. Liston, and of reintroducing to Mr. Wakley rather than to Mr. Hancock, for whose excision of Feb. 17th, 1851, it has been claimed."

Moreau, as we have seen, performed his operation on the 15th of April, 1792. His proceedings were as follows:—He made a longitudinal incision, beginning at the inferior and posterior part of the malleolus externus, continuing it upwards from three to four inches. He then made another incision, transverse, which extended from the inferior end of the former incision to the edge of the tendon of the peroneus brevis. He made another longitudinal incision on the inside, which began at the inferior and posterior part of the malleolus internus, and extended from three to four inches along the internal border of the tibia. Then, by a third incision, which began at the lower end of the tibia, he cut the skin transversely till he came to the tendon of the tibialis anticus. He disengaged the fibula from the tendons, ligaments, and in general from everything by which, at its inferior extremity, it is held in its situation; he passed the handle of a scalpel under it, and with a chisel he cut it across above the ankle. Wishing to cut the tibia above the malleolus before he turned it out of the joint, he separated everything that adhered to it; and then, passing the handle of his scalpel between the posterior surface of the bone and the flesh, he introduced between the spine of the bone and the flesh, in front of the bone the blade of a narrow saw, and cut the bone, sawing from before backward, which was a work of no small trouble. That being done, he turned the foot outward, and, making the piece of bone which he had cut off project, he detached it from the tarsus without difficulty. The astragalus being diseased, he removed the whole of its upper articulating surface, and a great part of its body, till he came down to what was sound. Now, contrast this with Mr. Liston's case, as described in the *Edinburgh Medical and Surgical Journal* of January, 1821. He removed the astragalus, scaphoid, and two cuneiform.

Again, contrast Moreau's operation with Mr. Wakley's original proceeding, as detailed in the *Lancet* of April 12th, 1851, the first of those referred to, and performed on the 27th of December, 1847. I quote Mr. Wakley's own words:—"The diseased foot (the left) having been drawn forwards so as to be free of the table, I made an incision from malleolus to malleolus directly across the heel. A second incision was next carried along the edge of the sole, from the middle of the foot to a point opposite the astragalo-scaphoid articulation; and another, on the opposite side of the foot, from the vertical incision to the situation of the calcaneo-cuboidal joint. These latter incisions enabled me to make a flap about two inches in length from the integument of the sole. In the next place, a circular flap of integument was formed between the two malleoli posteriorly, the lower border of the flap reaching to the insertion of the tendo Achillis. This flap being turned upwards, the tendon was cut through, and the os calcis, having been disarticulated from the astragalus and the cuboid bones, was removed, together with the integument of the heel included between the two incisions. The lateral ligaments connecting the astragalus with the tibia and fibula were now divided, and the knife was carried into the joint on each side, extreme care being observed to avoid wounding the anterior tibial artery, which was in view. The astragalus was then detached from the soft parts in front of the joint and from its articulation with the scaphoid bone, and the malleoli were removed with the bone-nippers. The only artery requiring ligature was the posterior tibial."

Take, again, Mr. Wakley's second case, thus reported in the *Lancet* of May, 1850:—"Mr. Wakley made a crucial incision directly over the outer malleolus, and having carefully dissected back the small triangular flaps, the whole of the diseased malleolar process of the fibula was now exposed, as well as the portion of the astragalus. Both these parts were evidently in a carious, partly in a necrosed state, and were excised principally by means of a gouge."

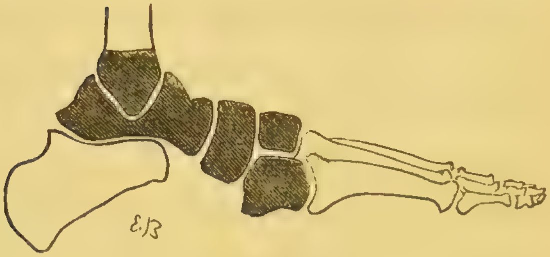
Although undertaken with the same object as that which actuated the elder Moreau—namely, to excise the ankle-joint solely, the operation which I performed, whilst attaining the same result, differed somewhat in certain details, which will be apparent as we proceed. Instead of making two incisions at right angles on either side of the joint, I commenced the operation with an incision behind, and about two inches above the external malleolus, carrying it forwards beneath that process across the front of the joint, and terminating about two inches above and behind the inner malleolus. This incision included the skin alone, without implicating the tendons or their sheaths. The flap thus formed was dissected up, and the peronei tendons were detached from the groove behind the fibula and cut through, as were the external lateral ligaments close to the fibula. With a pair of bone-nippers, I next divided the fibula about an inch and a half above its inferior extremity, and cutting through the inferior tibio-fibular ligaments detached the external malleolus. Now, turning the leg on to its outer side I cut through the internal lateral ligament, carefully keeping my knife close to the end of the tibia to avoid the posterior tibial artery. The tendons of the tibialis posticus and flexor communis were then detached from the groove behind the internal malleolus, and taking the foot in my two hands, the late Mr. Avery, who assisted me, holding the leg, I next dislocated the foot outwards, thus bringing the end of the tibia with the internal malleolus prominently through the wound. The soft parts being protected by a spatula, the internal malleolus with the end of the tibia were removed by a common amputating saw applied half an inch above the horizontal articulating surface. The upper articulating surface of the astragalus was next removed by a metacarpal saw held horizontally. After which the foot was restored to its proper position, the cut surface of the astragalus being adapted to the cut surface of the tibia, and the wound having been closed by sutures, except on the outside, which was left open for the free escape of discharge, the leg was placed on its outside on a splint, having an opening corresponding to the wound, and the patient was returned to his bed.

You will doubtless have observed that the parts here cut through were the skin, the peronei tendons, the internal and external lateral and the inferior tibio-fibular ligaments, and the lower ends of the tibia and fibula. In subsequent operations I preserved the tendons entire. In no instance have the anterior or posterior tibial arteries been wounded, and in no instance has it been necessary to apply a single ligature.

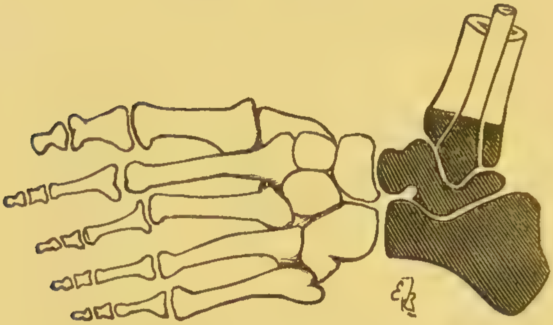
That the point may be set at rest, I here subjoin woodcuts showing the amount of bone removed in these several operations by Liston, Wakley, and myself, the darkly-tinted portions of the engraving marking the bones, or portions of bone, excised.

After considering these diagrams I imagine it must be admitted that, however honourable to their authors, the operations performed by Liston and Wakley assuredly were not excisions of the ankle-joint, and that consequently they in no way invalidate my claim of having been the first to introduce the operation for "excision of the ankle-joint" into the arena of British surgery.

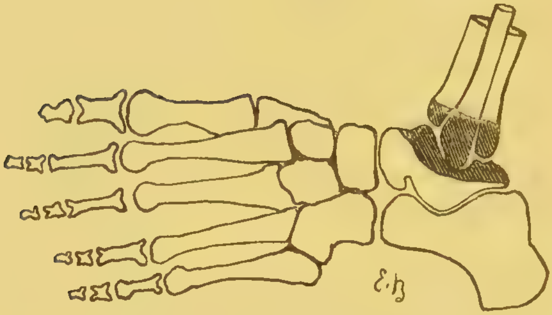
Although this operation has been performed by the late Mr. Jones, of Jersey, Mr. Canniffe, of Canada, the late Dr. M. S. Buchanan, of Glasgow, Mr. Barwell, Mr. Canton, Sir W. Fergusson, Mr. Hessey,



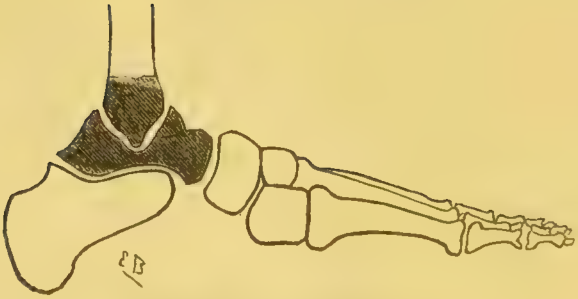
LISTON'S OPERATION.



WAKLEY'S OPERATION.



MY FIRST OPERATION.



MY SECOND OPERATION.

Mr. Holmes, and Sir J. Paget, it is not, as I have before observed, regarded with that general favour to which its merits entitle it.

"When," observes a writer in the *Lancet* in the year 1857, "the entire ankle-joint is involved in disease, with even a moderately diseased state of the lower end of the tibia, it is useless to attempt any other means than amputation."

"I have not excised the ankle-joint," writes Mr. Holmes Coote, "not having met with a suitable case. In young children such cases do well in course of time. In adults I do not approve of it."

Professor Humphry remarks (the *Lancet*, 1864): "The construction of the ankle-joint, and the disposition of parts around it, are by no means favourable to excision, and the operation in this part must always be undertaken with much hesitation. I have now performed it in four cases. In two, good, firm, useful feet remained, enabling the patients to walk well. In a third, the disease was very extensive, necessitating the removal of the whole astragalus and navicular bones, as well as the ends of the tibia and fibula; and amputation was subsequently performed. In a fourth, suppuration continued; phlebitis ensued; and the patient died six months after the operation."

Velpeau says: "Excision of the ankle-joint is always difficult, sometimes very dangerous. Roux's patient died. After the most complete cure the limb is necessarily shorter, and the patient can only walk by means of a high-heeled shoe. It offers, then, but little advantage over amputation of the leg."

Mr. Furneaux Jordan, of Birmingham, whose opinions merit our greatest respect and attention, has kindly favoured me with the following observations:—"A very strong objection to excision of the ankle is this, that the astragalus is not a long bone with an epiphysis in which the chief disease may lie, but a short bone consisting of a mass of cancellous tissue, throughout which the disease is more or less diffused. And as in the ankle, disease only rarely extends from the synovial membrane to the bone, the disease here, as in all allied cases (the extremities of long bones for instance), begins in the centre of cancellous tissue, and consequently can only be removed with the whole bone. I have seen two cases only; both confirmed the conclusions here arrived at. The pathological inferences are the result of a great number of examinations of cases in the ankle and foot. Of course, I infer that when disease begins in the extremities of long bones excision is inadmissible."

These are, as far as I have been able to ascertain, the principal objections which have been urged against the operation; and they may be summed up for the most part under the heads of difficulty of performance, and the opinion that in disease of the ankle-joint the mischief as a general rule originates and is located in the cancellous structure of the astragalus or of the lower extremities of the long bones. That in the former case the whole bone must be removed, whilst in the latter excision is wholly inadmissible.

The difficulties of the operation scarcely deserve consideration; in fact, they do not amount to anything which a surgeon with ordinary skill and acquaintance with anatomy may not readily overcome.

I have already expressed the respect in which I hold Mr. Jordan's opinions; but it seems to me that his remarks apply rather to the selection of cases than to the prejudice of the operation itself; that they are based upon the idea that because the bones of the ankle-joint and of the foot consist of cancellous structure, therefore disease of this region must of necessity originate in this structure and extend to the articulations; that disease commencing in the joint structures, and secondarily involving the bones, is a very rare and unusual occurrence; and that when a part of one of these bones is diseased the whole must of necessity be involved in the mischief.

In my previous lectures I have adduced abundant evidence to prove that the propagation of disease from the joint structures of this region to the contiguous surfaces of the bones is a much more frequent occurrence than was previously supposed; and I also proved that when this occurs the affected portion of such bones may not only be removed, but removed with safety and advantage to the patient.

The histories given by those labouring under disease of the ankle-joint lead me to infer that disease commences much more frequently in the synovial membrane than is here allowed by Mr. Jordan; and if we turn to the writings of Mr. Syme, we find that eminent surgeon dwelling upon the frequency of the disease originating in the joint between the calcis and astragalus as an argument in favour of his operation. I do not for one moment deny that in patients of strumous habits the disease, for the most part, begins in the cancellated tissue either of the astragalus or of the ends of the long bones, or of both. What I would urge is, that it is not by any means an invariable rule that persons suffering from ankle-joint disease are scrofulous, and that when this condition does obtain it is no argument against the operation of "excision of that joint."

Granted that disease commencing in the centre of the cancellous tissue of the astragalus necessitates the removal of the entire bone, is this a sufficient reason for sacrificing the whole foot? I have, as you will find in one of my cases, removed not only the entire astragalus, but a considerable portion of the os calcis also, and still the patient recovered completely. Nor am I disposed to admit the inference that when disease begins in the extremities of the long bones excision is inadmissible. It is not so admitted in excisions of the knee-joint; why should it be so fatal an objection to excision of the ankle? We have here the epiphysis of the tibia, which frequently sets limits to the disease; and the increase in the amount of bone to be removed is a matter of small importance indeed, when compared with the benefit conferred upon the patient by the preservation of the foot.

I have dwelt thus at length upon the objections urged by Mr. Jordan, because opinions coming from him have, and very justly have, great weight with the profession; and especially because, if adopted in their integrity, they must of necessity abolish all attempts at saving the foot, and condemn every case of disease of the ankle-joint requiring operation to Teale's amputation or to amputation of the leg; since they apply with equal force to Syme's and Pirogoff's amputations as to excision of the ankle.

In Professor Humphry's third case we are told that the disease was very extensive, necessitating the removal of the whole of the astragalus and navicular bones, as well as the ends of the tibia and fibula; it can scarcely be regarded therefore as an illustration of disease of the ankle-joint, or as evidence against an operation proposed for the removal of that joint, but it is valuable as illustrating the confusion existing in the minds of surgeons as to the true nature of the operation, and the want of exactness with which it is regarded. We have already seen excision of the end of the tibia, the astragalus, scaphoid and cuneiform bones, also of the ends of the tibia, fibula, the astragalus, and os calcis, described as examples of excision of the ankle-joint; and here again we have an operation proposed and destined for the excision of one joint, involving one synovial membrane and portions of three bones, applied to a case involving no less than five joints and five synovial membranes (and those the largest in the foot), as well as the removal of the whole of two bones and portions of two others; and, because amputation was subsequently necessary, it is adduced as evidence that the ankle-joint is "by no means favourable to excision," and that consequently "the operation in this part must always be undertaken with much hesitation."

Passing by Velpeau's monstrous objection that, because the patient is subsequently obliged to wear a high-heeled shoe, the operation offers no advantages over amputation of the leg, we next turn to the objections urged by Hussey, of Oxford.

A gardener, aged twenty-six, was admitted into the Radcliffe Infirmary, Oxford, January 6th, 1858, under Mr. Hussey's care, with disease of his left ankle, beginning after a sprain received at Michaelmas, 1856. The foot was extended; the toes pointed downwards; the muscles of the leg were generally wasted; the gastrocnemius and tendo Achillis contracted. There was much swelling about and behind the malleoli, with a large ulcerated opening on each side, directly over the malleolus. A probe passed in different directions did not detect any exposed bone. The front of the joint and the dorsum of the foot did not present any appearance of disease. The tarsal bones seemed healthy. He had in the previous autumn been five months in the hospital; but he gradually became worse, complained of greater and more constant pain, frequent starting of the limb at night, and increased swelling. An abscess formed at each side of the joint, the discharge from which soon became watery. He lost flesh, and was attacked with troublesome diarrhœa. He left the hospital; but, after an absence of three weeks in the country, he returned better in general health, but without improvement in the local disease. He asked to have the limb removed; but Mr. Hussey, desirous to save the limb, performed the following operation on the 15th of January.

A semilunar incision was made over the front of the joint from behind and above the outer malleolus to a point a little above the inner malleolus, dividing the skin and subcutaneous fat and areolar tissue only. The flap of skin was raised, the fascia opened on each side of the fibula, the peronei muscles separated from the fibula, and the bone divided by cutting-pliers about two inches above its extremity. The fragment of the fibula was seized by strong forceps and drawn forwards, the ligaments were divided, and the bone removed. After dividing the ligaments at the inner side of the joint, the foot could not be everted sufficiently to throw the inner malleolus out of the wound so as to use the saw for its removal; Mr. Hussey therefore applied the cutting-pliers to the lower end of the tibia above the malleolus. The blades were not equal in length to the whole thickness of the bone, the gouge was therefore used in cutting away so much of the cancellous structure and articular surface as seemed necessary. With his finger in the joint he felt the articular surface of the astragalus to be rough and bare of all cartilage, and he cut it away with a gouge. No vessel required tying. The foot, which before the operation was in a state of permanent extension, could now be flexed without difficulty. About a week after the operation erysipelas appeared about the knee and lower part of the thigh; this subsided favourably. In the middle of March the swelling about the foot and ankle, which subsided after the operation, had again slowly increased; the patient became weaker, the leg became much swollen, the wound opened, there was considerable discharge, and the patient became so much worse that on the 1st of June his leg was amputated, and he left the hospital well on the 17th of the following July.

Upon this case Mr. Hussey makes the following remarks:—"From the history and progress (it being thought that the disease affected the synovial membrane and cartilage rather than the bones) this seemed a fit case for the operation of making a free opening into the joint, or for removal of the articulation—if such an operation is admissible for the large joints of the lower extremity. However little hope there might be of saving the limb—and there was not ground for much—I was anxious to make the attempt, because I had not before found it necessary to amputate a limb for disease of any joint but the knee. The first incision was made in accordance with the published description of former operations. It was not here found to assist in rendering the other steps of the operation more easy of execution. In order to remove the malleoli, it was necessary to enlarge it at each side, so as to make it into the form of an **H**, with the transverse line curved instead of straight. In a joint distended with fluid from chronic disease, the eversion might, perhaps, be more easily effected; the contents in this case were little more than the remains of the articular cartilages and the pulpy and degenerated synovial membrane. The operation here failed to restore to the patient any use of the limb; nor did it succeed in rendering a further operation unnecessary. It seemed as if the disease went on steadily from bad to worse, neither checked nor aggravated by operative interference nor by the other treatment adopted. On examining the parts after the amputation, it appeared that a great accumulation of new bone had taken place about the lower end of the tibia, and that a large irregular mass extended on the fibula side, nearly, if not wholly, surrounding the lower end of the fibula. This, I think, existed at the time of the first operation, and the circumstance partly explains the difficulty found in the attempts to evert the foot. The opposing surfaces of the tibia and astragalus were rough, without any deposit of new bone, and without any appearance of commencing anchylosis. The bones of the tarsus were soft, and the articular cartilages were generally thin. There was not any carious bone. The muscles of the leg and foot were pale and bloodless; the appearance was rather that of maceration than of the degeneration commonly seen in the muscles of a limb when examined, after having been amputated for chronic disease of a joint."

I have given this interesting case at length, and, as far as the steps of the operation and the subsequent remarks are concerned, in Mr. Hussey's own words; partly on account of the value of the pathological observations, and partly because the impression under which Mr. Hussey appears to have laboured, that in performing this operation he performed an excision of the ankle-joint, seems to me to be entirely erroneous. Mr. Hussey informs us that his intention was to open the joint, and if possible to remove the articular surfaces of the bones. And, from the account he gives, it is evident that his intention was equally to effect this according to the plan pursued by the elder Moreau and myself: but it is equally evident that he did not succeed; that his proceedings in point of fact ultimately resolved themselves into a gouging away of diseased bone, whilst the result throws considerable doubt upon his having been able to do so completely. No one, I will venture to assert, who compares the operation as performed by the elder Moreau and myself with that performed by Mr. Hussey, will be inclined to admit that they are identical. In the two former, the articular surfaces of the joint, with the two malleoli, were removed by clean cuts with a saw, and the disease entirely removed at the same time. In the latter, the inner malleolus was left; and when the external malleolus had been cut away by pliers, the operation was completed by the gouge, portions only of the articular surfaces being removed—a proceeding which rendered it very doubtful whether the disease of the astragalus and tibia was entirely eradicated after all. The examination of the foot after amputation seems to me to confirm this view; for whilst the lower end of the fibula which was cut through by the pliers was nearly, if not wholly, surrounded by newly-deposited bone, the opposing surfaces of the tibia and astragalus, which had been submitted to the gouge, were rough, without any deposit of new bone, and without any appearance of commencing anchylosis whatever.

It is difficult to understand how the large irregular mass of new bone surrounding the lower end of the fibula could have existed at the time of the first operation, as supposed by Mr. Hussey. Had it done so he would scarcely have avoided seeing it at that time, as it must have interfered greatly with his reaching the tibia and astragalus with the gouge from the outer side of the ankle; and we must also remember that the lower end of the fibula, found surrounded by new bone after amputation, was not the lower end of the fibula of the time of the first operation, but a point of the fibula some inch and a half higher up. Hence the difficulty in the attempt to evert the foot cannot be attributed to this cause. Nor does there appear to have been any anchylosis about the joint; for although before the operation the foot was in a state of permanent extension, during the operation the articular surface of the astragalus could be examined by the finger, whilst after the operation the foot could be flexed without difficulty, even though the articular surfaces had only been gouged away so far as was deemed necessary. It is consequently more reasonable to suppose that this bony mass was thrown out from the periosteum of the lower end of the fibula in the interval between the first and second operations; and that the difficulty of everting the foot arose, not from the presence of this mass, but from the tendons of the tibialis posticus and flexor communis muscles not having been sufficiently freed from their groove and connexion with the lower end of the tibia. I have myself experienced this difficulty, and I consequently regard it as a point of considerable importance in the performance of this operation. In the case at present under discussion this is not even alluded to, the description merely stating that "after dividing the ligaments at the inner side of the joint the foot could not be sufficiently everted to throw the inner malleolus out of the wound."

I will appropriate but a few minutes to the discussion of the objection, that as the disease of the ankle-joint, especially in children, frequently (some go so far as to assert, always) disappears without interference, excision of the ankle-joint is altogether unjustifiable. It is curious to notice the antagonistic opinions entertained upon the same subject. Here are those who say, "You should never operate. If you only give time, the patient will be sure to get well." Others again are just as strong in their denunciations: "It is no use your attempting to save the foot, or any portion thereof; it is no use your doing anything short of amputation. If one bone of the foot is diseased, the whole are infected; and though they may appear sound at the time of your partial operation, disease will be sure to manifest itself actively in them in course of time, and you will then find that your partial operation has been useless." To reconcile such opposite theories is very difficult, if not impossible; it is better, therefore, to be governed by neither, as facts so frequently controvert both. We can hardly imagine that surgeons of all ages, of the highest talent and of the soundest judgment, should so universally have operated upon cases which could have been saved; whilst, on the other hand, it is almost incredible that so many patients after partial amputation or resection should so entirely recover if the second dogma be correct.

There can scarcely be a surgeon in existence of any experience who has not at some period of his career been obliged to operate upon the feet of children; and in those even of the earliest age—at the age of one year for instance—it has been found necessary for the preservation of the patient.

The objection, therefore, that as diseased ankle-joints frequently do well without interference, excision of the ankle-joint is unjustifiable, is not of much weight. It shows, I admit, the necessity of caution in the selection of proper cases on which to perform it. It may be an argument against its abuse, it certainly is not one against its employment.

We know that diseased ankle-joints do not invariably recover; we know that many such cases are annually submitted to either Syme's or Pirogoff's amputation, or to amputation of the leg. I have already shown that in one year, in England alone, and that recently, no less than thirty-four were amputated for this cause alone. The question for us, therefore, now to decide is, not whether these cases are to be left to Nature altogether, or to be submitted to operation; but whether those patients who suffer from disease of the ankle-joint deemed incurable must of necessity be deprived of their feet or legs without an effort being made on our part to save them. Experience has proved that in many such cases the foot has been saved, and the histories of many more afford convincing evidence that others might have reaped similar advantages had not these objections, and to me groundless objections and prejudices, been permitted to prevail.

But, again, it has been urged, it is so difficult in some cases to diagnose beforehand the exact extent of the mischief, that after the operation has been commenced, or even completed, it may be found inadequate for the removal of the entire disease. This apparent objection suggests a point of great importance, which, so far from militating against, greatly enhances the value of the operation, but which has been entirely lost sight of by those who oppose the proceeding. Should the operation, when commenced or even completed, be found ineffectual for the removal of the whole mischief, it does not present a single impediment to its immediate conversion into a Syme's or a Pirogoff's amputation; for, be it remembered, neither the posterior tibial artery, the firm structure of the heel cushion, nor the soft parts of the sole of the foot, are at all interfered with.

LECTURE VIII.

EXCISION OF THE ANKLE-JOINT—(*Continued*).

MR. PRESIDENT AND GENTLEMEN,

Contrast the objections urged against the operation of excision of the ankle-joint, noticed in my last lecture, with the opinions of the late Mr. Guthrie, Mr. Henry Smith, and others, and with the cases in which it has been performed.

"Domestic surgery, or that of civil life," says Mr. Guthrie, "has, in the operations of excision of the ankle-joint and of amputation in this part, repaid her Amazonian sister of military warfare for the improvements she has introduced into the great art and science of surgery."

Mr. Henry Smith, writing in 1855, observes: "More remarkable and perhaps more strikingly illustrative of the benefits of conservative surgery than any other case, is one in which excision of the entire ankle-joint, together with about three inches of the fibula, had been performed by Mr. Jones, of Jersey. It is impossible to describe accurately the extraordinary result which has taken place here.

The operator is very proud of his case, and well may he be. I have possibly had the opportunity of seeing and being engaged in as many operations upon joints as any other young surgeon, but I must confess that this ankle-joint case is beyond anything I have ever seen in that way."

The operator in this case was the late Mr. Jones, of Jersey, whose efforts for the improvement of surgery have rarely been equalled, never surpassed, and in whose death at a comparatively early age the profession has to mourn the loss of one of its most accomplished members, and one of the most strenuous and successful promoters of conservative surgery. The patient, an adult, some six months before, had sustained a compound Pott's fracture. Attempts were made to preserve the entire limb, but so much mischief was produced, both locally and generally, that Mr. Jones determined, against the opinion of all, to excise the ankle-joint. The operation was done, and the man made an excellent recovery. On looking at the limb, if it were not for the cicatrix across the front of the joint marking the line of incision, it would not be easy to know that any such operation had been done, for the parts look almost natural, there is a movable joint, and so little shortening that the patient can walk about with or without his boot briskly. The wound is perfectly healed, and, what is extraordinary in so short a time, the portion of the fibula which was removed has become regenerated.

Now turn to the no less brilliant case of Dr. Canniff, a member of this College, and late Professor of Surgery at the University Victoria College, Toronto, and to whom the honour is due of being the first to perform this operation on the other side of the Atlantic. I quote Dr. Canniff's own words:—

"The operation was performed in the way recommended by Mr. Hancock. The young man operated upon was twenty-one years of age, with a constitution in most respects good. The disease of the bones which led to the operation was, I think, chiefly if not altogether due to local causes. Having made the single incision through the integuments, as recommended, and dissected up the flap, the following pieces of bone were successively removed: First, the astragalus, one half of which was in a state of necrosis, and the other portion in a disorganised condition; then the external malleolus; after which the tibia was turned out, and a little more than half an inch sawn off. But the condition of the bone above was such that it was deemed necessary to remove more; consequently, the incision through the soft parts was extended, the parts dissected from the bone, and an inch and a half more of both tibia and fibula removed.

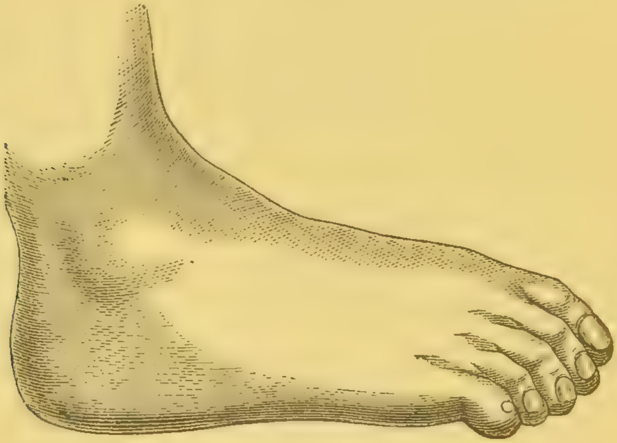
"At this time it was recommended by the surgeon assisting me, to amputate; but as I had strong faith in Nature's ability to heal, and as the patient had made me promise, if there was but a slight possibility of saving the foot, to give him the benefit of it, I determined to make the trial. The upper surface of the os calcis, to the extent of half an inch, was thereafter also removed by the gouge. By careful measurement of the bone excised it was found that fully three inches had been removed. The space, however, between the bones of the foot and those of the leg was perceptibly diminished by the contraction of the muscles of the leg. I confess my anxiety was great to see the result, for I was not aware of any precedent for so extensive a removal of bone. But no artery of any size had been divided in the operation, and *the diseased bone had been entirely removed.* A portion of the flap, in which was a cicatrix that had resulted from previous sloughing, subsequently perished, leaving a large opening, through which could be seen the end of the tibia. But, notwithstanding, the healing rapidly progressed. There was no great discharge, no inflammation, and water-dressing alone was used. At the end of nine weeks the limb presented the following appearance: a healthy-looking and limited cicatrix marking the incision through the skin; a very small opening internally, where had been the most sloughing; the foot reduced to almost its natural size and in a natural position. There is not more than an inch and a half of shortening. The bones of the leg have not as yet joined with those of the foot; the foot can be moved passively in any direction, yet there is a considerable degree of firmness, which has been constantly increasing. The patient can move the foot and toes in a natural manner. Within four months after operation he could rest the foot upon the ground, within six he could walk by the aid of a cane, and at the expiration of a year he could run upon it. I saw him on one occasion mount a flight of stairs, three steps at a leap. He wears a boot with a sole thickened three quarters of an inch; the ankle is supported on each side by a spring, and he walks with a very slight limp."

What a complete reply does this case furnish to the objections urged by Jordan and Velpeau!

Take, again, the following cases of those performed by myself:—

The first that of a boy aged eight, who, after several years of intense suffering, during which he had been under treatment at one dispensary and three metropolitan hospitals before he came under my care, was subjected to this operation. The progress of this boy was altogether favourable. The constitutional irritation was but slight throughout; the suppuration, though abundant, was never sufficient to create anxiety, and in six months he was able to walk about with perfect ease and comfort.

W. R——, aged twenty-five, born in London, when three years old slipped off the pavement and sprained his ankle, which became much swollen and caused lameness. In process of time matter formed, and three months after the accident the part was lanced, and a considerable quantity of matter let out, giving great relief. He then went to the seaside for three months, but his ankle getting worse, he was taken to Sir A. Cooper, who advised amputation of the limb, but this was objected to. He was next sent to Killarney, where he was attended by a gentleman, who, he says, "worked wonders by making him walk barefooted every morning while the dew was on the ground, and rub oil on his ankle before the fire every night, and at the end of six months he was so much improved as to be able to walk without a stick, and he continued to improve every year, though the part remained stiff." In the year 1855 he first came under my care for an ulcer on the side of the ankle, which got well in a fortnight; still the stiffness of the joint remained. Some little time after this he was induced to place himself under the treatment of a non-professional man, who pronounced the ankle to be dislocated, and, after oiling it for three weeks, is said to have snapped the bone into its place, after which he lost the stiffness, and could walk, he said, as well as he could wish. Eight months after this he slipped once more, and again went to his friend, who manipulated a second time. Again he fell, and again he went to his friend, but this time the manipulator failed in accomplishing his object, alleging that "the nerve resisted too much." So much mischief resulted, that my friend, Mr. Tucker, of Great Marlborough-street, whom he consulted, sent him to the hospital. At this time his ankle was greatly swollen, inflamed, and very painful. There was a wound near the external malleolus, leading to dead bone. Also another posteriorly, through which a probe could be carried to the inner side of the joint. Subsequently swelling appeared near the inner malleolus, accompanied by intense pain. An incision, followed by free discharge, gave relief, but his health ultimately became so much impaired that I proposed an operation, to which he readily acceded, and I accordingly excised his ankle-joint, assisted by my colleagues, Messrs. Canton, Hird, and Barwell, on the 10th of August, 1857.

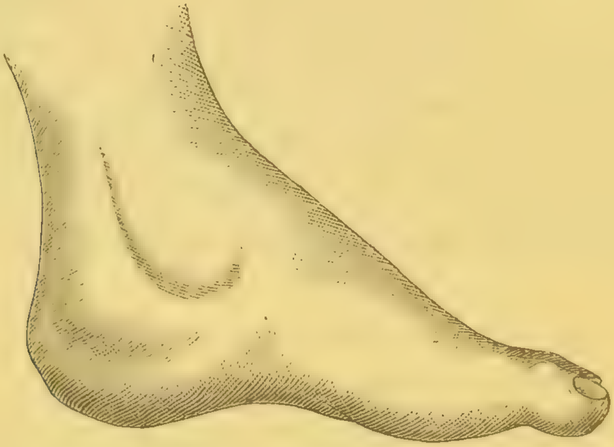


W. R.—FOOT AFTER RECOVERY.

Nothing could be more satisfactory than the subsequent progress of this case. The wound in front of the joint healed by first intention in about a week. Over the inside of the ankle it was healed in about two months, and by the 16th of December he was able to walk about. He was able, when I last saw him, to walk up or down-hill, up and down-stairs without a stick, and almost as well as another man with a perfect foot.

Case 3.—J. P——, aged six, was sent to me by my friend, Mr. Chapman, of Hounslow, in September, 1858. In the April preceding he first complained of pain in his left ankle-joint, unaccompanied, however, by swelling, discoloration, or lameness. On the 29th of August he leaped from the top of a wall about five feet high, and so injured the ankle that he had to be carried into a house. Great swelling ensued, accompanied by profuse suppuration.

When admitted he was very weak and feverish; his countenance anxious, and indicating great suffering. There was an unhealthy wound in front of the internal malleolus, discharging a large quantity of offensive matter, and a probe readily penetrated the joint, which was found extensively diseased, the cartilage being much destroyed. As his strength was rapidly declining, I proposed to excise the joint, and remove the diseased parts; and this was done on the 9th of October. The first steps of the operation were similar to those of the two preceding cases; but when the astragalus was examined, it was found that the disease extended through and beneath this bone, involving the os calcis to a considerable extent. The convex tibial articular surface and the whole body of the astragalus behind the interosseous calcaneo-astragaloid ligament were removed, as were the remains of the corresponding articular surface on the upper part of the os calcis, whilst the interior of that bone behind the interosseous notch was carefully gouged out before the disease could be eradicated, so that little more than the shell of the bone remained in this situation. The parts were then replaced *in sitû*, and the wound dressed. No arteries were tied. The boy suffered no constitutional disturbance. He progressed satisfactorily, and in March, 1859, or five months after the operation, was cured. He could then bear his weight on the foot, and walk without pain, and the wound was entirely healed.



J. P.—FOOT AFTER RECOVERY.

No doubt, I should think, can exist as to the superiority of this over Mr. Syme's operation in this case, which corresponded closely with that condition for which he so strongly advocates amputation at the ankle-joint. "But," says Mr. Syme, "in what is called disease of the ankle-joint commonly, the joint between the astragalus and os calcis is affected much more frequently than that between the astragalus and the bones of the leg; and even when the latter condition really exists, it would be easy to remove all the bone which would be essential for recovery, by sawing off a slice from the articulating extremities of the tibia and fibula, as the caries penetrates to no great depth of the cancellated structure."

That the disease of the tibia is not in all instances so superficial is proved by Mr. Canniff's case; whilst, therefore, we should be prepared to find it extend to a greater depth, the result of this case shows that, even under these more unfavourable circumstances, the result of the operation may prove equally beneficial.

I will here only allude to my fourth successful case, as it presents no features of interest differing from those of the other three.

The late Dr. M. S. Buchanan, of Glasgow, was the first to introduce this operation into Scotland. Unfortunately, his son, Dr. George Buchanan, to whose kindness I am indebted for the following particulars, is unable to furnish me with the date of the operation; it must, however, have been prior to the year 1860, as the lamented death of Dr. M. S. Buchanan occurred at that time.

"The patient having been rendered insensible by chloroform, Dr. Buchanan began his incision on the outer edge of the peroneus tertius, carrying it only through the integuments and subjacent cellular tissue in a semilunar direction to the outer edge of the tendo Achillis. This flap having been dissected back over the external malleolus, he divided the tendons of both peronei muscles, and by applying the saw to the malleolus and removing it, he exposed the joint at its lateral aspect. Dislocation of the astragalus, carrying the sole of the foot so as to make it look to the opposite leg, was easily accomplished. By this means the articular surfaces of the astragalus and tibia were exposed, and found in a carious condition. The astragalus was removed, and the articular surfaces of the tibia were scooped out with a gouge. The foot was now replaced, and the flaps secured. The patient did well for some weeks, but ultimately died of phthisis, from which she was suffering for some time previous to the operation."

Within the last few weeks the operation has been introduced into Ireland for the first time by Dr. W. Stokes, jun., with every prospect of success. He is himself about to publish the case, but he has, with great generosity, furnished me with the particulars of the peculiar method he has adopted, and one which he informs me is strongly advocated by Professor Langenbeck, of Berlin, who, during the late Schleswig Holstein campaign, performed five excisions of the ankle-joint, and had four good results. He has never, Dr. Stokes believes, performed the operation for disease. "I hope, however, he may be induced to do so when he has a fitting opportunity."

The operation being completed, Dr. Stokes invested the entire limb in a gypsum bandage in the following manner:—The limb being placed in a semiflexed position, he commenced by enveloping it in a flannel roller, taking care to place a good padding of French wadding over the situation of the wound. This was next covered with a coarse muslin bandage, into which he had previously rubbed a considerable quantity of gypsum powder; this bandage had been moistened with tepid water. The muslin bandage was then covered with a layer of semi-fluid plaster of Paris, and this, when nearly dry, was covered with another muslin roller, and, after a second application of plaster of Paris over this, the bandage was complete.

Four hours after the operation the patient complained of great pain in the wound; this, however, was relieved by cutting an oval aperture over it in the bandage three-quarters of an inch longer than the wound. The next day, the bandage being quite hard and dry, Dr. Stokes painted it all over with a solution of Dammar resin and ether, which soaked through the gypsum instantaneously. The limb was then placed, supported by a net, in a continual bath, which was productive of immediate relief from pain.

Dr. Stokes employs this continual bath largely, not merely in the after-treatment of operations, but also in many forms of injury and surgical disease. And as he sometimes keeps the part for several weeks continuously in the bath, the great desideratum is to preserve thew ater at an equable temperature without the necessity of disturbing the part by frequent renewal—to prevent, on the one hand, the temperature of the water falling below a given point, or, on the other, of its rising to a height which might be prejudicial. To effect this Dr. Stokes has had recourse to a most ingenious contrivance in the shape of a thermometer, by which the amount of gas supplying the burner under the still is proportioned, thus regulating the amount of steam generated by the still, and consequently the temperature of the bath.

I find that the ankle-joint has been excised 32 times for disease by British surgeons.

That the ages of the patients operated upon varied from 4 to 42 years.

That the sexes given show the proportion of 16 males to 6 females.

That of the 32 patients operated upon, 21 recovered with good useful limbs, 7 died, 2 suffered secondary amputation and recovered, whilst the result in 2 was doubtful.

The proportion of deaths consequently is a fraction above 21 per cent., a large proportion, I must admit, when compared with that of Syme's amputation. But it is not in reality so great when we inquire more closely into the matter; for instance, of the 7 deaths, 4 are reported to have died of consumption, of which disease 1 is stated to have been suffering at the time of operation; another died of the effects of syphilitic poison in the system. We can scarcely attribute the deaths of these four consumptive patients exclusively to this operation; consequently, if we make allowance for them, we find the death-rate of average cases 10 instead of 21 per cent., whilst the mortality of amputation of the leg for disease in civil surgery is 26 per cent.

NOTE.—Since this lecture was delivered, Mr. Moore has kindly furnished me with the particulars of the case upon which he performed excision of the ankle-joint on February 25th, 1863.

He cut down on the fibula and excised the lower inch and a quarter of that bone. Continuing the incision in a curve across the instep to the anterior point of the inner malleolus, but not through the anterior tendons, he endeavoured to dislocate the foot inwards, but could not do so. He then sawed through the lower part of the tibia in a line with the section of the fibula, took away the outer portion of the lower fragment through the outer wound, and removed the upper surface of the astragalus. The inner malleolus could not be dislodged until an incision was made on the inner side of the ankle. The operation was followed by considerable constitutional disturbance, but he ultimately recovered, and in

July, 1864, wrcte from the country that he could walk well; and in January, 1865, he showed himself to Mr. Moore. He was then in good health, without any swelling of the limb; the wound was completely healed, the ankle was firmly anchylosed by bone, and he consequently turned out his foot in walking; the loss in the length of the limb was 1¼ inch. With the aid of a stick he could walk four miles a day, but if he exceeded this distance his foot swelled. In the house he laid the stick aside.

I have also received the following kind note from Sir James Paget:—

"MY DEAR MR. HANCOCK,

"Your interest in the surgery of the foot makes me think that you may like to see the patient with this note. I excised the articular surfaces of the tibia, fibula, and astragalus, for very marked strumous disease, five years age. The healing was extremely tedious, but the result appears good enough to justify the operation.

"Yours, &c.,

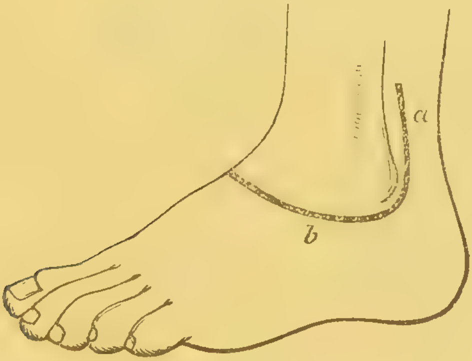
"JAMES PAGET.

"Harewood-place, Nov. 12, 1867."

The result was all that could be desired, and the patient, who appeared most grateful, informed me that he had suffered from the diseased ankle for 20 years previous to operation.

Some surgeons make their incisions through the skin according to the plan proposed by the elder

Moreau—namely, a longitudinal incision behind each malleolus, with a short horizontal one connected with it at right angles below the process. The late Dr. Buchanan limited his incisions to one extending from the peroneus tertius to the tendo Achillis, whilst he attacked the joint entirely from its outer side. I have never seen the operation performed in this way, but I have seen it done according to Moreau's plan, and I infinitely prefer the one semilunar incision extending across the front of the joint to behind the malleoli on either side, penetrating only to the fascia below, as in my own proceeding. When the flap thus made is reflected we have plenty of room wherein to manipulate; we can see the condition of parts and what we are doing; we can detach the tendons sufficiently from their grooves behind the malleoli to do away with the necessity of cutting them across; we greatly facilitate the eversion of the foot; and, as we can see what we are about, we



a Incision behind malleolus.
b Continuation across front of joint.

are able to avoid wounding the posterior tibial artery—a point of vital importance to the success of the proceeding, since that mainly depends upon the anterior and posterior tibial arteries being preserved in their integrity. The advantage of this method, moreover, is greatly enhanced when, from long-continued disease, the soft parts around the joint are rendered thick and unyielding.

Again, if we meddle with an ankle-joint at all, no matter how limited the disease may seem to be, it is better to excise the entire joint than to leave any portion behind. It is true that I shall have presently to relate a most successful case of Mr. Wood's, which seems to controvert this doctrine; but this case is so exceptional in its results that it proves the general rule and the soundness of the proposition. It is not always easy to judge from the appearance of the surface to what extent the mischief in the cancellated structure has proceeded; and however carefully and completely we may endeavour to gouge the disease out, we rarely succeed so entirely that some portion is not left behind. In partial excision we expose our patients to the dangers attending wounds of joints wherein so much mischief occurs from the impediments to the free exit of matter; in complete excision, on the contrary, we free the entire joint, remove these impediments, and get rid of the joint structure—bone is brought in direct contact with bone, and the process of cure is rendered more certain and more simple. These observations apply with equal force to those cases in which one or both of the malleoli have been allowed to remain.

Mr. Statham excised the astragalus. A year afterwards he removed the two malleoli. The parts never healed, and the man suffered so much that at his own request Mr. Bowman amputated the leg three years after the first operation.

Mr. Price gouged away the astragalus and horizontal surface of the tibia, and left the malleoli. Eight months after he was obliged to operate a second time.

In another case Mr. Price gouged away the astragalus and articular end of the tibia, the posterior end of the cuboid, and a portion of the fibula. Three months afterwards he was obliged to amputate the leg in consequence of abscess.

In June, 1852, Mr. Solly gouged away the external malleolus, a portion of the astragalus, and the horizontal articulating surface of the tibia of the left foot. On July the 2nd he performed a similar operation on the right foot of the same patient. On October 2nd he again operated upon the left foot, and in April, 1853, he again operated upon the right. The patient, however, ultimately recovered. On June 18th, 1852, Mr. Solly gouged away carious bone from the end of the tibia and from the astragalus. On July 10th he was obliged to amputate the leg.

In Dr. Buchanan's case the external malleolus and astragalus were removed, but the articular surface of the tibia was "scooped out with a gouge, and the internal malleolus left." The patient died of phthisis.

The younger Moreau in the year 1796 gouged away from a youth, aged seventeen, the astragalus, the internal malleolus, and about an inch and a half of the lower end of the tibia. "Above this," he says, "the solid part of the bone was sound, but not so the cancelli, which were so much diseased that I was obliged to introduce the gouge, and take away about two inches of them. The result was not so favourable as was expected. The wounds were a long time in healing; the fibula, having no assistance from the tibia in sustaining the weight which it was obliged to support, sank down upon the external side of the foot, which was thrown inwards, so that the lad rests now on the outside of his foot; that, however, does not prevent him from walking. I allowed the inferior extremity of the fibula to remain, thinking that Nature, by reproducing that portion of the tibia which I took away, would finally give by both bones a solid support to the patient; but the event was not what I expected. In a similar case now I would cut off as much from the fibula as from the tibia."

Mr. Hussey, as we have seen, sawed through the fibula and removed the external malleolus, but he gouged away the horizontal portion of the tibia and upper surface of the astragalus, leaving the internal malleolus. Six months afterwards he was obliged to amputate the leg.

The cases here quoted appear very conclusively to prove the proposition, that if we meddle with the ankle-joint at all we should remove the whole, and not a portion only, of the joint; as, considering the comparatively few times that partial excision has been performed, the results have been most grievous when compared with those wherein the opposite plan was pursued. I would also add that, where practicable, the bones should always be removed by the saw, and the employment of the gouge avoided as much as possible. With the saw we are enabled to cut through the bone with very little violence to the cut surface, which is smooth, and for the most part retains its vitality. But with the gouge these advantages are lost; we never can tell with any degree of certainty whether some amount of disease may not be left behind; we inflict an amount of violence, bruising and crushing, which the parts, already weakened by the pre-existing mischief, cannot repair: and thus the operation fails. The disease either proceeds unchecked or with increased rapidity, or, if arrested, the parts are too much damaged to take on the process of reparation. When this occurs it is commonly ascribed to extension of the mischief, to want of power in the patient, to the existence of scrofula or some latent taint in his system or constitution; but that these supposed causes are not always the true ones is strongly exemplified in the case of the foot amputated by Mr. Hussey. Here the end of the fibula, separated by a clean cut of the saw, was surrounded by a large mass of bone structure, thrown out, there can be but litle doubt, from the periosteum and cut end of that bone itself; but the gouged opposing surfaces of the tibia and astragalus, we are told, were rough, without any deposit of new bone and without any appearance of commencing anchylosis. We must admit, therefore, in this case, at all events, that either the diseased portions of the tibia and astragalus were not removed at the time of the first operation, or that the injury done to the parts was so excessive as to be beyond their power of reparation. The result cannot be charged against the weakness of the patient, or the presence of scrofula, or other taint in his constitution. Had either of these latter reasons obtained, it would have affected the fibula equally with the tibia and astragalus; we should scarcely have had an entire absence of all effort at reparation in the latter, whilst in the former the process, not only of recovery, but of reproduction, progressed so vigorously and abundantly.

I have very little doubt that when excision of the ankle-joint is better understood, and the cases to which it is applied are more carefully selected—when the vast benefits it is capable of affording to the patient are more extensively known and appreciated, the prejudice with which it has hitherto been regarded will fade away, and that it will be more generally adopted, and take its proper position among the standard operations in surgery. We have seen that of the seven cases which terminated fatally, four died of consumption and one of syphilis. Such can scarcely be adduced as adverse evidence, since death would equally have followed any other operation. By the most patient and careful investigation we cannot always obtain a previous history upon which any reliance can be placed. Patients, too, frequently suppress or deny facts of great importance, as regards their ultimate recovery; and it is only when too late to repair or obviate the mischief that the truth is revealed. All who know my friend and colleague, Mr. Barwell, are aware of the great care and patient investigation which he brings to bear upon the practice of his profession; still, in spite of all his inquiries and caution, it was some days after the operation, and when too late to remedy the mischief, that the woman admitted that which too surely proved her destruction.

If, therefore, there be any trace or suspicion of syphilis, neither this nor any other operation should be performed until the patient is rendered free from that malady.

In Mr. Barwell's case the parts bled freely when first incised, nor did pressure exerted on the femoral artery produce any appreciable diminution in the bleeding; but it ceased after the cut surfaces had been exposed a few minutes to the air. Successive hæmorrhage took place from day to day till she died, ten days after the operation; and it was remarked that the blood discharged seemed to be putrefied, and had a most offensive odour.

It was not till after her death that the facts of her having suffered from syphilis transpired, as there were no objective symptoms of that disease.

As bearing upon this subject, I would refer to a valuable and interesting case, related by Mr. Cæsar Hawkins before the Pathological Society on October 15th, 1850:—

"The joint between the os calcis and astragalus was partially anchylosed, and although *the astragalus itself was quite healthy*, the joint between it and the tibia showed the commencement of ulceration of the cartilage, demonstrating the manner in which the inflammation of the soft parts sometimes conveyed disease from one tarsal or carpal joint to another, and causing the removal of pieces of necrosed bone, or the excision of even an entire bone, to be not always successful." The case, however, was remarkable more from its history, as illustrative of the difficulty occasionally observed in distinguishing between simple scrofulous and malignant affections. The patient, a young woman, was admitted into St. George's Hospital with a large phagedenic ulcer on the inside of the ankle, excessively painful, and requiring large doses of opium for its relief, with much thickening of the soft parts; looking, in the sections, not unlike scirrus, and having in the centre some warty granulations, resembling the cancer of cicatrices (of which Mr. Hawkins has written a description), in the centre of which the probe passed down into the joint between the astragalus and os calcis without touching dead bone. After some attempts to heal these parts amputation was proposed, but declined by the patient. After a few months a mass of glands appeared low down in the groin, as large as an orange, as if enlarged by the contamination from the apparent cancer below, which did not ulcerate like strumous glands, but sloughed gradually away after previous ulceration of the skin; and as some were destroyed, fresh masses formed by their side, which went through the same process of sloughing during two or three months. About the same time there formed at the lower part of the femur, on its inside, a firm elastic tumour, obviously connected with the periosteum, but without bony deposit, about four inches in length and perhaps two inches in height. Soon after this a growth took place on the left side of the frontal bone, soft in the centre, and consisting, apparently, of a morbid growth in the diploe, making its way by pushing out the outer table, with a little absorption of the bone in the centre. Thus was formed a continuance of appearances, seeming to confirm the supposition of the malignant nature of the original disease, and quite sufficient to deter Mr. Hawkins from operating, for which the woman was now desirous. In two or three months, however, as it seemed, chiefly from the use of iodide of potassium and sarsaparilla, all these latter growths disappeared, the tumour of the thigh gradually subsided, the glandular masses all sloughed out, and the part healed; the growth of the diploe disappeared, the bone recovered its former level, and the skin lost its former sallow hue. Amputation was performed, and the patient was quite well a year and a half afterwards."

Although the above case is described as one of strumous disease of the os calcis, femur, and cranium resembling malignant disease, it seems to me to have been neither the one nor the other, but a very severe form of syphilitic mischief, presenting its local manifestations at the various parts indicated; and I am led to this conclusion by a somewhat similar case about which I was consulted some six years ago.

I was requested by my friend Dr. Page Burke to see a gentleman residing in the neighbourhood of Blackheath, said to be suffering from malignant disease of the ankle-joint, especially with reference to performing amputation of the limb. He had been suffering for four months, was extremely irritable, anxious, and emaciated; and described his sufferings as almost unbearable, entirely depriving him of rest, so that, as he said, he was almost worn out. He had no appetite; his countenance was leaden and sallow, and his pulse extremely rapid, and at the same time feeble. The ankle was much swollen, as was also the foot. Over the inner ankle was a large uneven ulcer, presenting all the appearance of a malignant sore, the surrounding skin being of a bluish brown red, and the discharge thin and very offensive. He described the pain as a dull, burning, gnawing pain, implicating the bone. But I was much struck with the manner in which he dwelt upon its increasing intensity towards night, and its subsidence towards morning. He denied ever having suffered from syphilis, although he admitted having had a slight excoriation about twelve months before, of which he had not taken any notice beyond touching it with caustic. Under these circumstances I suggested that the disease was syphilitic rather than malignant, and that it was advisable to submit him to a regular course of treatment before having recourse to operation. I accordingly ordered the iodide of potassium with sarsaparilla and five grains of blue pill every night, and the wound to be dressed with black wash. Under this treatment the patient recovered completely, and he is now walking about as well as ever he did.

Lastly, as regards excision of the ankle-joint, I would lay great stress upon the necessity of ensuring a free exit for the matter; and this is an additional reason for sawing away the whole joint rather than gouging away a portion only. By the former method we ensure a clean, smooth plane across the joint, clear of those irregularities which can scarcely be avoided when the gouge is employed, but which serve as so many barriers behind which the discharge is prone to collect, causing irritation, increasing the discharge, and retarding the cure.

It is here that the benefit of making the flap as practised in my operations is exemplified. By its looseness and freedom we are enabled to ensure the wound behind the ankles being kept open, which we cannot do when the right-angled incisions of Moreau are only employed. These, when the bones are removed, do not correspond to the resulting cavity in the ankle, whilst the flap thus made, free only in a portion of its extent, unable consequently to yield to the swelling and tension of the secondary inflammation, forms a valve, as it were, closing the external outlet, and depriving the patient of one of the principal sources of cure. Whilst, therefore, the wound in front of the joint should be closed and secured by wire sutures, those portions over the sides of the foot should be left entirely free.

The following case, for which I am indebted to Mr. Tudor, of Dorchester, is a good illustration of the value of these free openings:—

H. K——, aged twenty-three, a sailor, was admitted on board the *Dreadnought*, for the second time, on the 13th April, 1859, with disease of the ankle of two and a half years' duration. The previous history was injury to the foot by being jammed between two ships. He continued to work for a year, when he felt a painful, pricking sensation in front of the joint, accompanied with swelling. He was treated for twelve months in the British Hospital at Buenos Ayres, without benefit ; was sent home to England, and admitted on board the *Dreadnought.* The ankle was then very much swollen and painful, but there was no wound, nor sinus. He remained in the hospital four months, and was discharged much better, but still unable to walk. He was re-admitted on the 13th April, 1859, when his ankle was found swollen and puffy, with fluctuation, and a distinct grating felt between the astragalus and tibia. There were now two sinuses discharging pus, one situated in front of the joint, a little external to the mesial line, through which a small patch of denuded bone could be felt on the upper surface of the astragalus ; whilst the second, situated midway between the tendo Achillis and external malleolus, impinged upon the same point from behind.

June 9th.—Under chloroform an incision was made in front of the joint from the external border of the extensor communis in a curved line, about an inch behind the external malleolus. About an inch of this bone was sawn off, and the ligaments, as well as the tendons of the peronei muscles, were divided. The external and anterior surfaces of the astragalus were found denuded of cartilage, and the bone diseased. About three-fifths of the bone were removed by the saw and gouge, and the parts quietly brought together with sutures.

11th.—The wound looking red and congested, with a tendency to slough, the sutures were removed, and free openings made for the discharge.

Healthy action soon set up, and the man's health quickly improved, and he subsequently left the hospital with every promise of a useful joint.

Although as a general rule I strongly advocate the removal of the entire joint in preference to a portion thereof, I am free to admit that exceptional cases have occurred where "partial excision of the ankle-joint" has been attended with success. The case—the most worthy of record with which I am acquainted—is the following, operated upon by Mr. Wood, at King's College Hospital :—

A single woman, aged twenty-five, was admitted June 15th, 1858. Ten years previously she slipped and sprained her right ankle very severely, for which she was an inmate of Guy's Hospital for three months. The joint became stiff, and she could not walk upon it for twelve months. She was then for three years under the care of the late Mr. Lonsdale, at the Orthopædic Hospital, during which time an abscess opened in front of the internal malleolus. This never healed. Some time after this she received a kick on the heel of the affected foot, which caused great pain and swelling.

When admitted there was considerable swelling of the right ankle; the foot was slightly movable, but the attempt to move it gave her extreme pain. Three sinuses, left by abscesses, communicated with diseased bone, and passed upwards to the tibial portion of the joint, the largest being in front of the inner malleolus; a second, placed posteriorly, passed between the tendo Achillis and posterior tibial vessels and nerve; whilst the third, placed behind the outer malleolus, was directed inwards and forwards towards the tibia. An oily fluid appeared occasionally with the matter upon the dressings.

On July 29th the patient was placed under chloroform. Mr. Wood made an incision two inches long over the inner malleolus, and by gouge and forceps removed the whole of the diseased inner malleolus, exposing a piece of necrosed bone of the size of a chesnut, which included the greater portion of the tibial articular surface, completely denuded of cartilage, which latter lay detached in the cavity of the joint. This was removed, with a portion of gelatinous synovial membrane. The rough articular surface of the astragalus being removed with bone forceps, the bone was found to be quite healthy.

The patient rapidly recovered. The foot had a great tendency to turn inwards, from the lack of support caused by the removal of the inner malleolus, whilst the fibula remained in its place.

On November 23rd, 1859, Mr. Wood again saw his patient. She had become fat, and said she had never felt better in her life. All the sinuses had quite healed. "The leg is about three-quarters of an inch shorter than the other. She walks well and firmly, and with the slightest possible limp. The ankle is quite firm and stiff. A deep hollow marks where the malleolus formerly existed, and the inner arch of the foot is somewhat elevated and shortened. She says she can walk six miles without feeling tired, and that she never has pain in the ankle-joint."

A somewhat similar case, operated upon by Mr. Moore, at the Middlesex Hospital, on the 2nd of March, 1855.

A pale thin clerk, aged twenty-one, had disease of the ankle early in life, but the foot, though stiff, had been useful and free from active mischief for the last eight years. Eight weeks before an abscess formed, and he was admitted into the Middlesex Hospital, under the care of Mr. Moore, with three sinuses inside the ankle. There was much swelling over the lower part of the tibia and inner side of the joint, a little in front and behind, and none outside. The foot was extended and fixed. After the failure of treatment, Mr. Moore made an angular incision down the back of the tibia, along the lower edge of the inner malleolus, and across the front of the joint, through the tendons and anterior tibial artery. The joint was thus exposed from the tendon of the tibialis posticus to that of the extensor longus digitorum, which were not divided. On removing the internal malleolus, the diseased surfaces of the tibia and astragalus were exposed, and they were each sliced off quite smoothly, in a single cut, with sharp and large cutting pliers. The fibular part of the articulation was not interfered with, as it was quite fixed, and the whole of the diseased parts appeared to be removed. The result was that a gap was left between the end of the tibia and the top of the astragalus. There was little constitutional or local irritation, and the cut surfaces of bone granulated healthily. A fortnight after the operation there was some redness and tenderness over the external malleolus, with pain, which kept him awake one night. This all subsided. In another fortnight a bare piece of bone was felt on probing to the depth of the inner surface of the fibula. A month afterwards it appeared to have separated and been discharged, for the patient spoke of a pricking sensation which crossed the joint inwards, and on further probing no bare bone could be felt. By the end of May there was scarcely any discharge, and he soon after went into the country in good health, his ankle feeling strong, though the sinuses were not quite closed.

A young lady, fourteen years of age, sprained her foot whilst dancing. She was rather strumous, although her parents were healthy. At first she paid no attention to it, though after a little while she suffered excruciating pain at night. Mr. Solly saw her two months after the injury. She was then pale and thin, with a quick, irritable, feeble pulse, extremely nervous and anxious. The right foot was swollen across the instep to at least double the size of the other foot; there were two open abscesses, with nasty, unhealthy, purple edges, over the chain of cuneiform bones, which could be felt distinctly with the probe to be in a state of caries. Mr. Solly made an incision two inches long on the inside of the foot, directly through the abscesses down to the bone, and found the cuneiform median detached and floating in pus. He removed this, and gouged away the greater portion of the internal and external cuneiform bones. She was much relieved by the operation; but on the 12th of June, Mr. Solly was obliged to remove more carious bone, principally from the metatarsal bone of the great toe. She went down to Devonshire, and gradually got well, so that in two years she was quite sound, and could dance all night long, and walk any ordinary distance. She can move her foot perfectly. The only thing she cannot do as well with this foot as the other is standing on the heel with the fore part of the foot raised from the ground. Mr. Solly, who kindly furnished me with the particulars of this case, remarks: "I do not think that any instrument but the gouge would have produced so good a result. If the three cuneiform bones had been excised, there could not have been the reproduction of bone which has taken place, and the almost perfect foot."

I have here endeavoured to place fairly before the profession what has been done in this country as regards the operation of excision of the ankle-joint for disease. I have given the number of operations which have been performed—those which have succeeded, and those which have died. We have seen that, including only those of complete excision, and for disease, the former amount to 21, the latter to 7; whilst Paul's table of amputations of the leg, contained in his "Conservative Surgery," shows that 968 amputations of the leg were followed by 249 deaths. So that, whilst the rate of mortality of excision of the ankle-joint is 21 per cent., that of amputation of the leg is 26 per cent.

COMPLETE RESECTION OF THE ANKLE-JOINT.

British Surgeons.	Date.	Disease.	Sex.	Age	Life	Results. Use of Limb.
Hancock	1851	Caries	M.	8	..	Good
"	1857	"	F.	23	D.	7 months after. Phthisis
"	1857	"	M.	25	..	Good
"	1858	"	M.	6	..	"
"	1862	"	M.	14	..	"
Buchanan, Glasgow	1852	"	..	..	D.	6 months after. Phthisis
Jones, Jersey	1854	Accident	M.	..	..	Good
Statham	1854	Caries	F.	4	..	"
"	..	"	..	..	..	"
Calton	1855	"	..	..	..	"
Holmes	1855	"	M.	4	..	"
"	1857	"	M.	21	..	"
"	1860	"	F.	6	D.	"
Humphry, Cambridge	1855	"	M.	4	..	"
" "	1857	"	M.	31	..	"
Simon	1857	..	M.	42	D.	
Erichsen	1858	Caries	M.	17	..	Not known
Hussey	1858	" gouged	M.	26	..	Amputated
Morton, Glasgow	1860	"	F.	..	..	Good
Canniff, Canada	1862	"	M.	21	..	"
Barwell	1862	"	F.	..	D.	
Paget	1862	"	F.	25	..	Good
"	1862	"	M.	12	..	"
"	1862	"	M.	..	D.	Phthisis
Canton	1863	"	M.	..	..	Amputated
"	1863	"	..	..	..	Recovered
Heath	1863	..	..	..	D.	
Moore	1863	Caries	M.	21	..	Good
Davis	..	..	..	..	..	Doubtful
Delagarde, Exeter	..	..	..	..	..	Good
E. Canton	1866	Caries	..	..	..	"
Stokes, Dublin	1867	"	..	..	..	"
Sir W. Fergusson	..	3 cases	..	..	..	"
Hancock	1867	Caries	F.	21	..	Amputated
"	1872	"	M.	3½	..	Good
Canton	1866	"	..	..	..	"
"	1872	"	M.	31	..	"

Time will not allow me to do more than allude to the various simple dislocations connected with the ankle-joint. I will therefore at once pass on to those alarming cases in which, through accident, the joint is laid open and its internal economy exposed. Here I shall have the opportunity of relating some of the most brilliant achievements of modern surgery; indeed, it would almost appear that the more alarming and extensive the laceration the greater the chance of a cure, and the more happy the result.

J. N——, aged eight, residing at Newtown, was admitted into Leeds Hospital, under the care of Mr. Wheelhouse, on August 27th. He was playing in the street when he was knocked down and run over by a waggon, the wheel passing directly over the right ankle. On admission he was found to have a severe lacerated wound, extending from the internal malleolus anteriorly, passing across the ankle-joint round the limb to within about two inches of the internal malleolus posteriorly. The ankle-joint was completely laid open, so that the fore-finger could be passed into the cavity. The anterior tibial vessels and nerves were lacerated, and in consequence there was considerable hæmorrhage. A consultation was held, and all the surgeons agreed that amputation was necessary. The boy was placed on the operating table, when a further examination showed that the posterior tibial vessels and nerves were uninjured. It was then decided that, the patient being young and healthy, there was a possibility of the limb recovering without amputation, and that consequently the chance should be afforded him. The boy was therefore removed to his bed, his limb placed on its outer side, and cold water cloths ordered to be constantly applied. No further bleeding took place, and the wound healed rapidly. He suffered comparatively little pain, and retained perfect sensation all over the affected limb; throughout there was but little constitutional disturbance. He was made an out-patient on October 26th, just two months after this formidable accident.

A young married woman was, on December 22nd, 1849, knocked down by a wooden crate, which fell upon her left leg, striking her just above the ankle on the inner side, forcing the leg-bones through the outer skin and boot. Mr. Thompson, of Launceston, was called to her, and found a transverse wound four inches in length, across the outer ankle, and through it the tibia and fibula protruding. The foot was inverted to a right angle, and the joint completely opened, so that all the articular surfaces were exposed, except the inner surface of the tibia. A small piece of bone was chipped off from the outer malleolus. The soft parts were much lacerated, and the exposed surfaces covered with dirt and straw. Mr. Thompson decided upon giving the patient a chance, and seeing what nature would do for her. He accordingly reduced the bones, cleansed the wound, and brought the edges together with wet lint, &c. Considerable constitutional disturbance, with profuse suppuration, succeeded, and continued with more or less severity until the 17th of March following, when a small piece of dead bone was discharged from the outer ankle. From this time she gradually mended until August 1st, when another piece of dead bone, the size of a hazel-nut, was removed, after which the cure went rapidly on, and by the end of the month the wound was entirely healed. The joint remained stiff and immovable, but the tarsal articulation allowed so much power of flexion, that by the aid of crutches she was able to walk briskly.

Mr. J. H——, a builder, at the time of the accident was standing on a high wall, which suddenly gave way, throwing him to the ground, a large mass of the material falling on him. He sent for Mr. Parrott, of Enfield, who found the left foot everted, and the tibia protruding four inches and three-quarters through a wound occupying two-thirds of the circumference of the ankle-joint. As the articulating surface of the tibia was very much injured, Mr. Parrott sawed it off, and returned the bone to its proper situation. The edges of the wound were brought together by sutures, and the limb placed on a fracture apparatus. The fibula was fractured two inches above the malleolus, and again three from the knee. The patient was under treatment for six months, and during this time a small irregular piece of bone separated from the tibia, and was removed. The leg now, nearly two years after the accident, is about an inch shorter than the other, and not long since Mr. Parrott saw him digging a trench with this foot, and it was as strong as before the accident.

How brightly do these cases contrast with the following :—

A middle-aged man sustained a compound dislocation. The skin was torn across the front of the joint and the whole of its outer side. The lower end of the fibula protruded through the wound, whilst the tibia was dislocated forwards. The ligaments were ruptured, but no bones were broken. Amputation was performed, and the patient died in a few days.

These cases, however, it must be acknowledged, do not always terminate so favourably; still there can be no question that, where the slightest chance of success is present, every effort should be made for the preservation of the limb, especially as we now possess that invaluable local application, carbolic acid, which exerts such wonderful influence in preventing inflammation and suppuration. I am indebted to the kindness of Mr. Gay, in the mention of whose name we have a sure guarantee that the patient had the benefit of all that skill and sound surgery could afford, for the following case of compound and comminuted fracture of the ends of the tibia and fibula into the joint. Mr. Gay writes in January, 1866 :—

"I did not see the case at the time of the accident, but was consulted about it in the course of the first week after its occurrence. It had been put up, and apparently very well, and I did not think it desirable to disturb the limb. The case, however, did not go on well. The joint became much swollen and suppurated. I made free incisions, and relieved a large quantity of matter in front of the inner condyle, and some small portions of bone came away from time to time. The patient went on for a period of eight months, sometimes as if the joint was about to recover, and then with a sudden outburst of subcellular inflammation, extending up to the knee-joint. I tried again and again, and could discover no reason why these attacks should occur, or why the patient should not recover: the opening into the joint was free, and I could not discover any sequestra. At length the patient's health became so much impaired that I felt compelled to resort to amputation below the knee."

Although Hippocrates is stated to have removed the ends of the leg-bones for compound fractures and dislocations, it was not until the end of the last century that the practice became generally recognised, for during the intermediate dark interval the limbs of patients suffering from these accidents were invariably sacrificed. The honour of introducing this great improvement into surgery is undoubtedly due to Mr. Hey, of Leeds, who in the year 1766 sawed off two inches from the right tibia of a man aged fifty-six, who had been tossed by a bull, and sustained compound luxation of the right ankle. The patient recovered, and was able to walk.

In 1767, Gooch, in a similar case, removed the tarsal extremity of the tibia with success. Cases are also recorded by White, of Manchester, in 1770; and by Servius in 1778. In 1782 the elder Moreau, nineteen days after compound dislocation, sawed off the articular end of the tibia and lower end of the fibula, leaving the internal malleolus. The patient is stated to have recovered completely, with the use of a new joint. The operation then remained in abeyance for seventeen years, until the year 1799, when it was again performed by Hey, who removed an inch of the lower end of the tibia which had been cut through by a hatchet; by Sir A. Cooper, Evans, Averill, and Kerr, of Northampton.

The rules laid down by Sir A. Cooper are so practical and judicious that they must not be omitted here. "If," he says, "the patient be not excessively irritable, so as to occasion the muscles to be thrown into spasmodic action in the attempts at reduction, which leads to subsequent displacement when the limb has been reduced, bones should be at once returned to their places; but rather than amputate, I would cut off the ends of the bones." And he illustrates this doctrine by the following case of a boy, aged thirteen, suffering from compound fracture and dislocation.

"A large wound appeared over the outer ankle, through which the tibia and fractured extremity of the fibula protruded. One inch of the malleolus externus remained attached to the astragalus by its natural ligaments. I tried to reduce the limb, but found that the bone could only by great violence be brought on the astragalus, and that it immediately slipped from its place. Finding the lower end of the fibula was very loose and movable, I removed it with the scalpel. I then sawed off half an inch from the tibia, and reduced the bone, which remained *in sitû*, as there was no force of muscular action upon them on account of the shortening of the bones. The patient got well."

In 1805, Mr. Taylor, surgeon to a colliery at Wakefield, showed Mr. Hey five specimens of the lower extremity of the tibia, sawn off in as many cases of compound dislocation of the ankle. In one the extremities of both tibia and fibula had been removed; in two the portions were very small. They all recovered, and walked firmly, but some were above twelve months before they did so.

In the year 1812, Mr. Hicks, of Baldock, took away an inch and a half of both tibia and fibula, stripped of periosteum, from a stage-coach driver, who had sustained compound dislocation of both bones. The patient got well, with very little shortening. He was able to follow his occupation, and got up and down from his box as well as ever he did.

In the same year we find this operation performed by the late Mr. Lyme, of Sandport, and Mr. Fletcher, of Gloucester; whilst in 1818, Mr. Cooper, of Brentford, removed an inch of the tibia and fibula with successful results.

From this period the operation came into more general use, and by none more successfully than by MM. Josse and Ladent, who, in 1819, excised two inches from the right tibia, and two and a half inches from the left tibia and fibula of a girl, aged sixteen, who had compound dislocation of both ankle-joints. In four months the patient could walk, dance, jump, &c. The left ankle was anchylosed, but this was compensated by increased mobility in the medio-tarsal joints. In the right the tibio-tarsal movements remained.

Heyfelder gives 26 examples of this operation, of which 5 died, and 1 suffered consecutive amputation. Jaeger, on the other hand, records 24 cases, of which 23 proved successful, whilst 1 only died, five days after the operation.

Mr. Greenhow, of Leeds, has kindly furnished me with a recent example of this accident:—

A pitman, aged thirty-two, on September 21st, whilst at work in a pit, was knocked down by a mass of coal falling from the roof, and striking him with great force on the inside of his leg, just above the right ankle, causing compound fracture of the tibia and fibula into the joint. The whole of the lower end of the tibia was separated from the shaft of the bone, and exuded from the wound, being attached by a few ligamentous fibres only. The broken fibula also projected considerably through the wound.

It was not easy, without injurious handling, to discover the exact condition of the astragalus, but it could scarcely have escaped fracture. The detached portion of the tibia was immediately removed, and was found to comprise nearly the whole articulating surface, though the inner ankle remained *in situ.* The fracture of the fibula was two inches above the ankle, which also remained in its proper place. The wound extended for about three inches across the fibula, and as the latter could not be reduced, a portion was carefully sawn off, after which the leg was laid on a pillow on its inner side. No untoward symptoms, either local or constitutional, ensued, and on November 23rd the wound had entirely healed. No deformity remained, and he was able to move about upon crutches, gaining strength daily.

Mr. Garraway, in the *British Medical Journal* for October, 1862, lays down the axiom, that in these cases we should remove enough of the tibia and fibula to prevent contact with the astragalus, and thereby prevent anchylosis, thus securing a movable joint, and he illustrates his position by the following case:—

A girl, aged ten, getting over an iron railway, fell, suspended by her leg. When seen the bones of her leg were found projecting two inches on the external aspect, and her foot was turned up at right angles. Mr. Garraway could not reduce the bones, and he accordingly removed about an inch to prevent the bones touching the astragalus, and applied splints, with cold-water dressing. No untoward symptoms supervened, and at the end of three months she was able to walk with crutches. Fifteen months afterwards she was able to walk with scarcely any lameness. The motions of the joint were quite free, and there was scarcely any deformity.

Callus has apparently been thrown out to form an internal and na external malleolus; and whether there is that simple ligamentous union between the tibia and astragalus which Sir A. Cooper describes as the result of his experiment on the dog, or "as I (he says) am disposed to believe, restored cartilage and synovial membrane," I leave to others.

It is questionable whether the inner and outer malleoli were, after all, formed as here stated, of callus. In all probability the fracture had so occurred that the epiphyses of the tibia and fibula remained *in sitû*, attached to the foot, as, when the pieces of bones which had been cut off were examined, the inner and outer malleoli were found wanting. It is very questionable, moreover, whether anchylosis takes place in these cases so frequently as is here implied; indeed, in many of the recorded cases the reverse is distinctly stated. We have seen in the case of Walsh, of Worcester, that it did not take place; and Mr. South also affirms that in the instances which have fallen under his notice, anchylosis has not generally followed. Mr. Rhodes, of Huddersfield, in a case of compound dislocation, was obliged to remove a portion of the fibula, as well as to enlarge the opening in the skin, through which the bone had protruded. The patient did well.

Notwithstanding the statement by Mr. Syme, reported in the tenth volume of "Braithwaite's Retrospect," that "in the Royal Infirmary of Edinburgh he finds that of 13 patients who had suffered compound dislocation of the ankle, and were not subjected to amputation, only 2 recovered; and that even in the event of recovery, the foot generally remains in such a state of stiffness, weakness, and sensibility to external impressions as to render it an incumbrance rather than a support to the patient,"—I say, notwithstanding these adverse comments, the results here detailed fully prove the value of the proceeding, and seem to me fully to warrant its extension to those complicated cases of fracture and dislocation of the ankle-joint without wounds of the skin, where the difficulty, and in some instances the impossibility, of restoring the parts to their normal position has been productive of so much suffering and such bad results to the patient; since they show the comparative impunity with which the ankle-joint, complicated as it is, may be laid open, so long as the opening is large and direct, and the confinement of discharge and consequent constitutional disturbance carefully guarded against.

NECROSIS OF MALLEOLI.

I would here allude to a class of cases of great interest and of equal practical importance, from the great resemblance which they bear to diseases of the ankle-joint, and the consequent danger of their being mistaken for that mischief. I allude to the presence of a sequestrum in one or other of the malleoli or their immediate neighbourhood. Whether from being more exposed to external injury or not, the external malleolus seems to be the seat of this mischief much more frequently than the internal, and indeed the two extremities of the fibula are liable to its existence. I have had cases of necrosis of the head of the fibula, wherein the symptoms so closely resembled disease of the knee-joint as to require a very careful examination to distinguish between the two; whilst in the external ankle, the thickness and swelling of the soft parts around the joint, the pain upon movement of the part, the inability to bring the heel to the ground, or to bear the weight of the body upon the foot, are all symptoms which assimilate it to more serious condition of disease of the ankle-joint itself. The history of the case, the situation of the wound over or close to the malleolus, and the capability of moving the joint when the patient is under the influence of chloroform, will, however, in most instances, enable the surgeon to form a correct opinion of the true nature of the mischief; at all events, they do so with sufficient frequency to justify the surgeon in making an exploratory examination before having recourse to more serious measures.

Three years ago I operated upon a man, aged thirty-four, at the Charing-cross Hospital, for this disease. He said that nine months before he had had great pain in the outside of the left ankle-joint; that, being unable to give up his work as a labourer, the pain became more severe, and ultimately an abscess formed, since which time he had been unable to walk. When I first saw him he was complaining of great pain, especially when the part was moved; there was considerable thickening and swelling around the joint, and he was unable to bring the heel to the ground. Directly over the outer malleolus was a small opening, which, examined by a probe, led to dead bone. Having placed the man under chloroform, I found I could move the joint freely, and I therefore made a crucial incision through the skin over the lower end of the fibula, and applied a trephine over the opening in the bone, taking care only to remove the external shell. This done, I exposed a sequestrum, about the size of a hazel-nut, which having removed, I brought the wound together, and the patient recovered perfect use of his foot, although he was two months in doing so.

In the following very interesting case there was a sequestrum in the lower end of the tibia, in addition to one in the external malleolus :—

R. M——, aged sixteen, was admitted into Charing-cross Hospital, under my care, on April 17th, 1866. He stated that in 1859 a piece of bone was discharged from his sternum. In January, 1866, his left ankle began to swell on its outer side; an abscess formed, which burst, and a large quantity of matter escaped.

On admission, the ankle was much thickened and enlarged; moving the joint gave him great pain. There was an opening just above the outer malleolus, leading down to dead bone, the edges of the wound being surrounded by fungous granulations. On May 12th I cut down upon the malleolus, and with a small trephine removed the outer shell of bone, including the opening, and, as in the last case, exposed and removed a small round sequestrum. Upon examining the cavity left by the removal of the sequestrum with the end of my little finger, I discovered a second opening on the inner side of the malleolus, and communicating with the lower end of the tibia, and an examination with a probe showed the existence of another sequestrum in this situation. I therefore again applied the trephine through the first opening, and removed the corresponding portions of the inner shell of the malleolus and the outer shell of the tibia; and by this means I was enabled, with a pair of long forceps, to extract the sequestrum from the tibia, which was about the same shape and size as that removed from the fibula, and without any damage to the ankle-joint. Considerable discharge followed the operation; but this was to a great extent removed by the free employment of the iodine paint, and he was able to move about, and ultimately left the hospital at the end of July.

In some cases, as in the following, for which I am indebted to the kindness of Mr. Wearn, of Longton, in Staffordshire, the interference with the movements of the joint is much less.

"A. B—— injured his ankle-joint about six years ago, but has worked off and on as a collier since then up to six weeks back, when he came under surgical treatment for pain and swelling over the lower end of the fibula. This was poulticed, and in a little time matter formed, which was let out. About nine days ago I was called to see the case, as another surgeon had said 'there was nothing more could be done but to amputate above the joint.' Upon examination with my finger and probe I am able to make out that the only bone diseased is the lower part of the fibula. All the other bones appear to be perfectly sound, together with perfect movement of the joint in every direction, and without pain. Large external fungous growths have sprung up, but his general health is good."

As Mr. Wearn paid me the compliment of asking me my opinion upon this case, I suggested that it was in all probability a case of necrosis of the external malleolus, which could be best removed by the application of a trephine.

The late Mr. Hunter, of Margate, also kindly informed me that on the 12th of July, 1864, he removed a sequestrum from the external malleolus of a man, aged twenty-one. The patient was discharged from the hospital cured on the 25th of the following October.

The following is a still more valuable and interesting case :—J. S——, aged twenty-six, a shipwright, was admitted into Exeter General Hospital, under the care of Mr. Kemp, suffering from disease of the ankle-joint of three years' duration. He had been in the hospital two or three times before. Mr. Kemp exposed the outer malleolus, and removed a circular piece of bone with a trephine, and extracted a large piece of dead bone from the astragalus without difficulty. The operation was followed by great pain, which lasted for several hours, but it was combated by opium. No bad symptoms followed. The wound healed in seven weeks, and the patient was enabled to walk well.

Grist removed the entire external malleolus for caries limited to the external malleolus; at all events he described it as such, but it is questionable whether he did not mistake the nature of the case, which in all probability was of the same character as those under consideration. The mischief appears to have been entirely restricted to the external malleolus; the motions of the ankle-joint were unimpeded, and the ankle-joint itself was unaffected. However, Grist cut through the peronei muscles, removed the malleolus, and filled up the deep cavity with charpie. Violent inflammation succeeded, but the wound is said to have healed in two months, and at the end of three months the patient went to work. He could adduct the foot, but neither abduct nor rotate it. He retained the power of extension and flexion almost to the same extent as before, but this was affected at the medio-tarsal end, not at the tibio-tarsal articulation, which was anchylosed. The patient died three months afterwards of consumption, and Grist has given the following description of the parts:—The tibia was anchylosed to the astragalus; the astragalo-scaphoid capsular ligament was very loose and extensive; the fibula closely approximated to the tibia, and was firmly united to it. There was no regeneration of bone, but the periosteum was continued directly into a ligamentous substance, which formed a sort of blind pouch around the cut end of the fibula, and passed over to the bones of the tarsus.

Edward W——, a small pale child, aged three and a half years, was admitted, 21st November, 1871, suffering from disease of the ankle-joint, which the mother attributed to a sprain.

I excised the ankle-joint on 9th January, 1872.

The disease was confined to the tibia and upper surface of the astragalus, and the lower end of the tibia with the articular surface of the astragalus were removed, after which the limb was placed on a back-splint and dressed with carbolic acid lotion.

The dressings were changed for the first time on 1st March, when the parts presented a very healthy appearance, the opening on the inner side being filled up to a level with the skin, whilst that on the outer side was closing in rapidly by healthy granulations.

The dressings were again changed on the 25th March, when the wound was progressing most favourably.

The child left the hospital cured.

I am indebted to the house-surgeon of the Charing-cross Hospital, for the particulars of the following case:—

C. M—— is a strong, well-built man, aged thirty-one. Has had pain in his right ankle for eight years, and on his admission into Charing-cross Hospital in October, 1871, the joint was swollen, tender, and utterly useless, as he was unable to bear the slightest pressure upon the foot. There were two small openings on the outer side of the joint, through which there was a constant discharge of pus.

On December 9th, 1871, Mr. Canton excised the joint, according to Mr. Hancock's method. The disease was found to involve the whole of the articular surfaces entering into the joint, but not to have extended to the other tarsal bones.

The leg was placed on a back-splint with foot-piece, and slung in a Salter's cradle, having the wound covered with folds of lint soaked in a watery solution of carbolic acid (1 part in 60), and kept constantly saturated with the same by means of a bottle syphon attached to the cradle.

The dressings were changed about once a week, but the limb was not raised from the splint for two months.

The man's progress has been highly satisfactory, and at no time has there been any constitutional disturbance, his appetite having been remarkably good throughout. The parts have become anchylosed, and the patient may be pronounced cured.

LECTURE IX.

MEDIO-TARSAL, OR CHOPART'S AMPUTATION.

Mr. President and Gentlemen,

This operation has for its object the removal of the anterior portion of the foot at what has been termed the medio-tarsal articulation, or that formed by the os calcis and astragalus on the one part, and the navicular and cuboid bones on the other. In this, known as Chopart's amputation, the os calcis and the astragalus are preserved in their normal positions, and the ankle-joint remains intact.

It is very remarkable, observes Velpeau, that the honour of having introduced or originated this operation should have been awarded to Chopart. He never mentioned it until the year 1787; whereas Hecquet of Abbeville, in 1746, showed a case to Winslow in which he had removed the fore part of the foot in front of the calcis and astragalus. Vigaroux also asserts that in 1764 he had amputated a foot through the tarsus for gangrene; whilst Lecat not only performed this operation, but systematically published it in the year 1752.

Remarkable as it may have appeared to Velpeau, the honour of originality has been most justly awarded to Chopart. Vigaroux amputated through the metatarsal bones, and not through the medio-tarsal joint; Hecquet of Abbeville never operated at all; and how Velpeau could have fallen into this error I am at a loss to imagine.

A female residing at Abbeville, four or five months advanced in pregnancy, was seized with malignant fever, and treated by Hecquet. She recovered from this, but was shortly afterwards attacked with intolerable pain in the right foot, for which she again consulted Hecquet. The applications he ordered soothed the pain, but the day after the foot appeared black, cold, and without sensation. In spite of all remedies applied to the foot during four or five months, the metatarsus and toes separated *en masse*, and from time to time the cuneiform, scaphoid, and cuboid bones, until the astragalus and os calcis alone remained. The patient recovered completely, and subsequently went through a natural confinement.

M. Robert, on the other hand, observes that Hecquet of Abbeville showed in 1746 that amputation might be performed between the first and second rows of tarsal bones, on a woman suffering from gangrene (the case I have just narrated), but that no surgeon had since noticed the operation until Chopart described and performed it on the 21st August, 1791, for a case of carcinoma occupying the metatarsal bones, and extending between them. He thus, as you will observe, fixes the date of introduction by Chopart at four years later than that indicated by Velpeau—namely, 1791, instead of 1787. And this, in all probability, is correct; since Chelius, who states that it was first foreshadowed by Garengeot and Heister, first performed by Du Vivier, but first described by Chopart, refers to *Fourcroy's Journal* of 1792; whilst Boyer, evidently a great admirer and supporter of Chopart, and who speaks with the authority of personal knowledge, not only fixes the date as the 21st August, 1791, but adds that "Chopart was so modest, and disapproved so much of the practice, so prevalent nowadays, of proclaiming one's name in the journals, that it was only at his (Boyer's) express solicitation that he consented to his case appearing in *Fourcroy's Journal.*"

In this case Chopart made two incisions, one on each side of the foot, extending from the astragalo-scaphoid and calcaneo-cuboid articulations as far as the tumour. A transverse incision on the dorsum of the foot then joined these two at their anterior extremities. This flap reflected back, Chopart cut through the extensor tendons and the dorsal ligaments. He next luxated the bones by depressing the front of the foot, and, carrying his knife behind and below the bones, he cut from behind forwards, through the soft parts of the sole, an inferior flap, a little longer than the upper one. Secondary hæmorrhage took place upon two occasions; but, in spite of this, the patient recovered, and left the hospital on the 9th of November, or eleven weeks after the operation, able to walk on that foot as well as on the other.

Boyer himself performed the same operation at the battle of Eylau, on a Capt. Deschamps, who was cured in two months. Capt. Deschamps was afterwards cavalry instructor at St. Germains, and retained the appointment until that school was suppressed. Boyer, who frequently saw him, asserts that the captain walked and mounted his horse with almost as much facility as he ever had done.

Simple as is the description of the *modus operandi* here given, it does not appear that Chopart either published or was governed by any especial anatomical rules in its performance; for although the medio-tarsal is infinitely less complicated, and more easy to disunite, than the tarso-metatarsal articulation, surgeons who more immediately followed Chopart by no means found the operation so easy of execution—indeed, Chopart himself always described it as being very difficult. And it is a fact, says Roux, that, in the year 1799, Pelletan, although he had the skeleton before him, was nearly three-quarters of an hour before he succeeded in disarticulating the joint.

To Richerand and Bichat belong the honour of having converted this difficult proceeding into a very easy one, by pointing out the value of the tuberosity of the scaphoid bone as a guide; whilst Dupuytren added to this the projection furnished by the head of the astragalus, and the somewhat triangular depression between the two. These points in most instances well mark out the internal extremity of the articulation; whilst the external is found at a spot midway between the projection of the fifth metatarsal bone and the lesser tubercle on the outer side of the os calcis bounding the groove for the long peroneus tendon. We must, however, be prepared for modifications. Thus extensive swelling and thickening may obliterate the scaphoid projection, &c., altogether. The presence of a sesamoid bone in the tendon of the tibialis posticus may cause embarrassment; whilst, as Pilchon has pointed out, the calcaneo-scaphoid ligament may be completely ossified, as he proved by a preparation which he exhibited to the professors of the Faculty in support of his thesis. In a subject, whilst demonstrating this operation to my class, I found the astragalus not only anchylosed to the calcis, but to the navicular bone also.

Various modifications have been proposed in the performance of this operation. We have seen that Chopart made a somewhat long quadrilateral flap by three incisions, and a somewhat longer plantar flap.

Richerand, instead of a quadrilateral flap by three incisions, made one semilunar incision, convex anteriorly, a little in front of the joint.

Klein and Rust proposed to enter the joint at once on its dorsal aspect.

Blandin insisted on the necessity of cutting a little in front of the joint, to prevent the head of the astragalus being denuded, as well as to leave the tendons longer, so that their adhesion to the cicatrix might be facilitated.

Poullain, on the other hand, advised two lateral semilunar flaps, commencing from the head of the astragalus above, and terminating at a corresponding point in the sole of the foot.

A great desideratum to the surgeon is to be able to enter the articulation readily, and for this purpose the directions laid down by Chelius appear to me to be ample. "The operator," he says, "places the *tip* of his forefinger *on* the prominence or tuberosity of the scaphoid, and the flat of his thumb *behind* the prominence of the fifth metatarsal bone. A line drawn across the dorsum of the foot *behind* the finger and thumb indicates the joint."

There is a difference of opinion as to the treatment of the bones in this operation. Some surgeons point out the unequal projection of the two bones; others, the variation in their relative projection in the different positions of the foot; some, again, regard the investing articular cartilage with disfavour, others as an agent of safety to the patient. Roux, for instance, observes: "The presence of the articular cartilage does not increase the danger. I agree with Blandin, that it protects the bony tissue; in fact, I have seen a case wherein, after medio-tarsal amputation, the flap sloughed; the exposed head of the astragalus covered by degrees with granulations, springing from the circumference to the centre of the wound, without the cartilage undergoing any change, and as the granulations advanced over it they gradually became adherent until they constituted a new cutaneous surface, thin, but very solid. On the other hand, the spongy tissue of the bones exposed by the saw is anything but a security. The membranes investing the cells and venous canals in all directions appear to me of a nature to develope either inflammation, followed by necrosis, or phlebitis, tending to pyæmia. This opinion, so generally prevalent, should lead (all other points being equal) to the preference of disarticulation over amputation through the bones of the tarsus. This is still more dangerous in young than in old people."

Having already shown how purely theoretical these observations are, I will not dwell upon them further in this place. I will content myself with giving the practical observations of Sir Wm. Fergusson, the result of experience, not theory: "I invariably saw off the exposed articulating surfaces of both astragalus and calcis," observes Sir William. "The annoyance which I have seen from exfoliation of the articular surface of the astralagus, as well as the doubts as to the flaps from the sole of the foot being sufficiently long, induced me to adopt this practice, and I have been so well pleased with the results, that for the last six years I have invariably removed not only the end of the astragalus, but also a thin slip from the os calcis;" and he adds, "a similar practice has been followed in Dublin within the last few years."

Probably few operations in surgery have had so many objections urged against them as has the one under consideration. "That when performed for disease, this disease still remains in the os calcis and astragalus, even though apparently sound at the time of operation." "That it leaves too great a length of limb." "That from the dense structure of parts there is danger of sloughing of the flap." "That it is frequently followed by inflammation and suppuration in the course of the sheaths of the tendons, pyæmia, and death." "That it results in a painful condition of stump, necessitating amputation; a turning over of the stump; the concentration of the weight of the body on one point of the heel; retraction and twisting of the heel," have all been urged against it by men of the highest position and greatest experience, and are consequently entitled to our best attention.

Dupuytren, in his "Leçons Orales," observes, "Neither Chopart nor his imitators calculated the grave inconveniences or dangers attending his operation.

"We all know how necessary it is to preserve as much as we can of the foot, so that the heels and bones of the tarsus may support the weight of the body. By Chopart's operation we deprive the patient of the necessary point of support in walking and standing, so that the limb becomes very inconvenient and completely useless.

"Moreover, the tibialis anticus and posticus being divided, their antagonism to the gastrocnemius and soleus is destroyed, and the foot is consequently drawn backwards."

Dupuytren adds that he frequently observed inflammation and severe constitutional irritation follow the operation performed at this articulation, the mechanism of which is very complicated and the surfaces uneven.

For these reasons he completely rejects this method, and asserts that partial amputation of the foot at the tarso-metatarsal articulation is infinitely preferable, and that we should never do so further back, unless forced by the nature of the accident.

Roux, who is a determined antagonist to the procedure, points out the dangers resulting from the different lengths of the two bones; the difficulty of covering them with soft parts; the consequent cavities in which blood and pus collect, leading to fistulæ and a protracted and difficult cure; the danger of gangrene from the pressure of the angles of the projecting bones against the flap; and the extent of articulating surface not always limited to the part apparent in the wound. He dwells likewise on the variety of texures which enter into the flap, muscles, fibrous aponeuroses, tendons, sheaths, &c.

Mr. Syme, in 1855, in a clinical lecture, observed: "In this operation the astragalus and calcis are left; and though they appear perfectly sound at the time of operation, yet the disease frequently recurs, as you may learn from the fact that I once performed three secondary operations within the period of twelve months upon stumps in which Chopart's operation had been practised." Had Mr. Syme stopped here, this objection, coming from him, would have had great weight. But, unfortunately for his proposition, he continues: "The bones I hold in my hand were removed in one of these operations, and you will observe that, as in all other cases of the same kind, *anchylosis* has taken place between the astragalus and os calcis, whilst the latter bone has previously been drawn up by the action of the gastrocnemius, so as to prevent the patient from resting on the proper part of his stump. The same preparation shows the portions of the tibia and fibula that are removed in amputation at the ankle. They include, as you may see, the malleolar projections and a thin connecting slice of bone, merely sufficient to ensure removal of the articulating cartilage. In preserving the astragalus, therefore, you have a bone which is particularly prone to disease."

I do not understand how Mr. Syme arrived at this conclusion. So far from proving the liability of disease to recur in the os calcis and astragalus, or the peculiar proneness of the latter to disease, the preparation would seem to prove the converse—that not only were the bones exhibited not diseased at all, but that these bones have in themselves the power of resisting and setting bounds to disease when set up in other tissues, and extending by continuity to their articulating surfaces; whilst the anchylosis so forcibly dwelt upon clearly shows their inherent power of repairing the mischief resulting therefrom. This objection thus forcibly urged by Mr. Syme is, I am aware, maintained by other surgeons ; but it is not supported by the statistics of the operation, since of 104 cases, exclusive of those mentioned by Mr. Syme, I only find two followed by secondary amputation, and this for retraction and painful cicatrix, and not for recurring disease.

More serious, because more frequent, objections are the retraction of the heel, the twisting and turning over of the foot, and the consequent painful condition of the stump.

We have seen that this retraction occurred in the three cases alluded to by Mr. Syme, and necessitated secondary amputation. M. Jules Roux urges very strongly that this operation is so often accompanied by a painful condition of the stump, from the twisting of the foot, and is followed by such bad results as to walking, that for some years he has been led to confess that the tibio-tarsal amputation possesses incontestable advantages over it.

Even Boyer, Chopart's great supporter, is obliged to admit that retraction may take place, though he asserts that it can always be prevented by proper precautions. When it does occur, the anterior extremity of the stump is thrown strongly downwards; the heel is drawn upwards and backwards. The shape of the stump is completely altered: its dorsum is directed forwards, whilst its anterior surface, with the cicatrix, is pointed downwards. Hence the weight of the body, instead of resting upon the natural integuments of the sole of the foot, falls almost directly upon the cicatrix and anterior surface of the stump, especially upon the anterior, inferior, and external angle of the os calcis.

It is not so certain that this retraction can always be prevented, even by the greatest care. In two cases of my own it took place, in spite of everything I could do; not during the process of healing, for when first healed there was no retraction, but it gradually took place after the patient began to move about. This was first observed by Mark Antony Petit, in 1799, and to remedy the defect he divided the tendo Achillis subcutaneously; thus rendering this operation and himself famous, from the former being the first example of tenotomy on record, and he the first surgeon to perform it.

In the year 1815, M. Villermé, surgeon to the Hôtel des Invalides, in Paris, published a most interesting account of the results of this operation. "During a certain number of years," he says, "we have received at the Hôtel des Invalides more than one-twentieth of those soldiers who had suffered amputation through the tarsus, and we have carefully observed that during fifteen months or two years after the operation these soldiers suffered pain in the cicatrix, inflammation, and too often ulceration, from walking, after which the pain became so insupportable that they were glad to submit to amputation of the leg. Even those in whom no ulceration took place entreated to have the leg amputated." He then adds: "There is a soldier at present in the same hospital, admitted with an ulcer on each anterior extremity of the portion of the foot remaining after partial amputation of both feet. We amputated both legs, and the man assured me he could walk much more easily on these stumps than he could before, although the stumps were barely healed." M. Villermé cannot certainly be accused of being prejudiced in favour of the operation.

In 1839, Velpeau published that out of five operations he had not met with a single instance of retraction. Blandin counted one in eleven, and M. Robert acknowledges to one in three. Various reasons have been assigned for this retraction; but they all appear to resolve themselves into the destruction of the balance between the flexors and the extensor muscles, the abnormal attachment of their tendons, and the consequent undue influence of the gastrocnemius and soleus.

In 1843, Dr. Stanski amputated a leg upon which

Chopart's operation had been performed in 1839. The patient, not being able to walk, had in 1842 undergone division of the tendo Achillis and the removal of a portion of the os calcis without deriving any benefit. Upon dissection, he found that the tendons of the back of the leg—viz., the tibialis posticus, the long flexor of the great toe, and the flexor communis digitorum, were firmly attached to the anterior portion of the inferior surface of the os calcis. The tendons of the two peronei muscles were also attached to this bone; so that the pulleys around which they play being posterior to their insertions, their contractions caused the os calcis and astragalus to be pointed downwards, as in extension. The tendons of the tibialis anticus and the extensor communis were inserted on the skin, and their insertion consequently being movable, these muscles exerted no influence over the bones, and the long extensor of the great toe, inserted into the posterior border of the anterior facet of the astragalus, was the only muscle to cause anything like flexion. Nearly all the os calcis in front of the superior articulation had been removed; but the greater part remained as well as the astragalus, which was carious. Both the bones were drawn so much backwards and upwards that the os calcis posteriorly touched the posterior border of the articular surface of the tibia. The os calcis was likewise strongly fixed in extension by the posterior fibres of the lateral ligaments, especially by those of the external, which formed a strong solid cord. The astragalus was luxated forwards, and was almost completely out of the tibio-fibular mortice, so that its anterior articular surface looked downwards. After relaxing the whole of the posterior tendons, it was impossible to replace the astragalus, or to bring the calcis forwards, the latter being so firmly fixed by the external lateral ligament.

This dissection is valuable, not only because similar descriptions are rare, but also because it explains why secondary division of the tendo Achillis after the operation so frequently fails; for we here see that it is not only the tendo Achillis, but also the tendons of the deep layer of muscles at the back of the leg, which cause it; whilst, when once caused and completed, it is maintained by the posterior portions of the lateral ligaments.

Division of the tendo Achillis at the time of operation is not so universally adopted as it might be with advantage to the patient. Some cases certainly appear to do well where it has not been practised; but notwithstanding, it is better, as a general rule, to do so, it does not increase the danger of the operation, and it undoubtedly places the patient in a better position. But to obtain the most certain results the tendon should be divided as far as possible from its attachment to the os calcis, for near that spot the fascia is so dense as to prevent due separation of the cut ends of the tendon.

Mr. Bryant has kindly furnished me with the particulars of a case in which he especially notes the non-division of the tendo Achillis, and that six months afterwards there was no retraction of the heel.

But division of the tendon at the time of operation does not always succeed in preventing retraction. It is stated in the *Lancet* for 1857, vol. ii. that Sir W. Fergusson performed Chopart's operation in a case of club foot, and at the same divided the tendo Achillis. In healing, however, the heel was drawn up, and he consequently again divided the tendon subcutaneously.

When retraction, or painful cicatrix, is confirmed, simple division of the tendon so frequently fails in affording the desired relief that its utility under these circumstances is very questionable; nor can we be surprised at this want of success, when we bear in mind that during the healing process, whilst the tendo Achillis is drawing up the heel, the other tendons are contracting new attachments, and accommodating themselves to the altered relation of parts; so that although the tendon Achillis must be regarded as originating the retraction, these tendons in their altered relations contribute in no slight degree in maintaining the mischief. Hence, division of the tendo Achillis alone is insufficient. Still this is by no means a valid reason for abandoning the proceeding altogether, and at once resorting to amputation of the leg. We should, on the contrary, have recourse to the twofold proceeding of dividing the tendo Achillis and of separating, by subcutaneous section, the newly-formed attachments of the other tendons from the anterior surfaces of the bones.

The objection that suppuration in the course of the tendons is a frequent result of Chopart's amputation is much exaggerated, although it does sometimes occur.

Mr. Jones operated upon a man, aged 26, a patient of Mr. South's in St. Thomas's Hospital, who had met with an accident on the 2nd December, 1860. He performed Chopart's amputation. Suppuration subsequently took place behind the malleoli, but the patient ultimately recovered four months after the operation.

Mr. South operated upon a cabman, aged 24, on 10th January, 1863, for caries of the first row of tarsal bones. Suppuration in the course of the tendons followed, but the patient left the hospital May 11th, 1863, 121 days after the operation.

Secondary ulceration of the stump will also occasionally take place. A girl, aged 17, was operated upon, on the 22nd April, 1848, by Mr. James, at the Exeter Hospital. Everything went on well, and she was made an out-patient, able to walk well; but ultimately ulceration of the stump appeared.

On the other hand, Mr. Charles Williams, of Norwich, has kindly sent me the following particulars of a case in which Chopart's amputation was successfully performed for ulceration of a cicatrix following a burn:—

A foundry boy, aged 14, stepped into some molten iron, thus burning his right foot severely and deeply, so that subsequently all his toes sloughed away. In about five months the ulcers had healed, and he was discharged cured. In less than a month, however, a cicatrix, which existed across the dorsum of his foot, on a line with the tarso-metatarsal articulation, gave way; and although every known form of treatment was resorted to for above six months to induce the sore to heal, it would not, and recourse was therefore had to its removal by Chopart's method. The tendo Achillis was not divided. The wound healed readily, and an excellent and useful stump was the result. Mr. Williams often saw this boy about the streets. He could walk fairly, but not without the aid of a stick.

Death from pyæmia follows this as well as other operations. A shoemaker, aged 16, was admitted into the Southern Hospital, Liverpool, November 25th, 1857, with strumous disease of his metatarsal bones. His health was much exhausted by a troublesome cough, loss of appetite, and frequent attacks of diarrhœa and sickness. After a month, as no improvement had taken place, Mr. Hamilton determined to amputate the foot; but having ascertained that the astragalus and os calcis were not implicated in the disease, though there was some doubt as to the rest of the tarsal bones, he performed Chopart's operation on the 23rd December. A very good flap was formed from the skin of the sole of the foot, and was united to the upper by three sutures. Pyæmia set in, and the patient died eighteen days after the operation.

J. K., aged 24, was admitted into the Leeds Infirmary, under the care of Mr. Wheelhouse, February 14th, 1865, suffering from a severe smash of the anterior part of the left foot, caused by a railway waggon (loaded) passing over it. All the toes were completely crushed. There was compound dislocation of the second, third, and fourth metatarsal bones ; and the soft parts were severely crushed and bruised.

Four and a half hours after admission an irregular Chopart's amputation was performed, the anterior flap being made up of two side portions of skin, owing to a bruise on the dorsum of the foot, whilst a large flap was taken from the sole. On February 18 there was considerable inflammatory swelling of the foot, accompanied by high febrile disturbance. On February 27 double pneumonia supervened, the right lung being most affected, and the patient died a few weeks after of pyæmia.

Mr. Holmes Coote writes me: "We have in our museum a specimen of a foot in which a sort of natural Chopart's operation has been performed. The patent suffered from an attack of acute pericarditis. The heart's action became embarrassed, and the greater part of the front of the left foot became gangrenous. I had to amputate the limb. I injected the parts removed.

"The specimen shows what becomes of the divided vessels. Their minute branches become greatly enlarged and tortuous, and the larger vessels form loops by means of such enlargement of their branches."

These untoward results, though not occurring so frequently as some would have us believe, and not so fully dwelt upon in this country as they have been abroad, have still been met with sufficiently often to create distrust in the operation, and to raise an undue prejudice against it. It may be well, therefore, to devote a few minutes to the inquiry whether, in the event of a case in which the condition of parts limits our choice of operation to this, Pirogoff's, Syme's, or Teale's amputation, we may not so perform this operation that, whilst we preserve to the patient an increased length of limb and an ankle-joint intact—no slight boon I should imagine,—we may at the same time prevent the supervention of such mischief.

One cause of retraction and painful stump is not making the plantar flap of sufficient length. Union by first intention is thus prevented; suppuration ensues; it extends along the tendons and up their sheaths; and we have then not only a tedious cure but are obliged to depend for that cure on the ordinary process of granulation and cicatrization. This inflammation unites not merely the cut edges of the skin, —skin to skin,—but at the same time glues, as it were, the cicatrix and skin to the subjacent bone, causes constant dragging upon the stump, and the painful cicatrix made still more painful by the gradual attenuation of the soft parts around and at the point of adhesion, rendering the part intolerant of pressure, and liable to ulceration, which is such a severe addition to the patient's sufferings. To obviate this, in performing Chopart's operation I have always carried the plantar flap as far forwards as the roots of the toes.

M. Robert has noticed that in this operation suppuration and its attendant ills occur more frequently, and terminate more unfavourably, among those performed for accident than among those necessitated by disease; and to support his view he gives the results of 24 cases, 6 for accident and 18 for disease. Of the traumatic, 3, or one-half, died; of the remaining 18, only 2, or one-ninth, died. The number of cases is too small for us to arrive at any definite conclusion, but it may serve to account in some measure for the lamentable results observed at the Hôpital des Invalides, though I am inclined to attribute them in a great degree to some such constitutional wrong or irritability as that alluded to by Sir W. Fergusson in the description of his own case—induced by the fatigue, anxiety, and suffering of an arduous and hard-fought campaign; for be it remembered, the observations were made in the year 1815.

But, after all, this increased danger of operations after traumatic over organic lesions, though worthy of notice, is not peculiar to Chopart's method; it is what is universally observed thoughout the whole range of surgery, and may be readily accounted for by the fact that when we operate for disease we remove a source of suffering of more or less duration, and our operation thus affords actual relief; whereas, when we operate for accident, the operation, performed on parts in a state of health, so far from being a relief, is an additional shock and violence done to the patient, and hence the untoward results. In corroboration of this view I find that of 36 operations performed for accidents, 8 proved fatal; whilst of 103 performed for caries, only 3 resulted in death. So that, whilst of the latter the mortality is a fraction below 3 per cent., that of the former is as high as 24 per cent.; pyæmia being the most frequent cause assigned in both classes of cases.

Sir W. Fergusson prefers Chopart's operation to the more extensive mutilation at or above the ankle-joint. "It has been asserted," he remarks, "that the heel is drawn so much backwards and upwards that the weight of the body will be thrown upon the cicatrix and the anterior ends of the bones. But if the stump is kept in good position during the dressing, I do not think there is much cause for anxiety on this score." He adds: "Within the last few years I have met with one case. Having made an excellent stump on a young man's foot, it was found that, as he attempted to walk upon it, there was induced a kind of turn or twist backwards, whereby the heel was thrown up and the cicatrix downwards. In this condition there seemed a tendency for the ends of the tibia and fibula to slip downward and forward, and the result was a severe strain upon the lateral ligaments. I divided the tendo Achillis by a subcutaneous incision; but, although this let the heel down, I was obliged ultimately to remove the two bones at the ankle-joint. This is the only instance of a painful stump after Chopart's operation which has ever occurred to me, and I am disposed to attribute it to peculiarity of constitution more than to any imperfection of the proceeding recommended by Chopart; and my reason for so doing is, that the stump at the ankle, though good in shape, became painful also."

Mr. Crompton, of Birmingham, has kindly entrusted me with the preparation I now show you, taken from a gentleman upon whom he performed Chopart's operation. The patient was so grateful that he volunteered to call and show me the stump; and certainly nothing could be more satisfactory.

Mr. Moore, who attributes the suffering in a great measure to the pressure exercised by the head of the os calcis upon the soft parts in walking, removes the interior inferior angle of that bone. He performed Chopart's operation four times during the years 1855-56; in the first case as it is usually done, in the three others removing the anterior inferior angle, as already stated. In the three latter cases the patients walked confidently in two or three months' time; but three others which he knew of, where this was done, could not walk many months afterwards, from the pressure of the edge of the os calcis. In another case, in which he was consulted, half of the lower flap sloughed off, and opium was prescribed, which seemed to arrest the destruction. Sufficient distinction has not been made between retraction of the heel and the painful cicatrix. They have been too much mixed up together, and the painful cicatrix regarded as dependent on the retraction of the heel and the consequent pressure upon the face of the stump. They should rather be considered as distinct, the one arising from muscular contraction, the other from insufficiency of flap, and adhesion of the attenuated cicatrix to the bone. True, such a cicatrix is intolerant of pressure and liable to ulcerate, and the ulceration so produced is liable to extend to the bone beneath; but the contraction of the heel does not produce the painful and adherent cicatrix, any more than the painful cicatrix produces the retracted heel, and there is no reason why a well-formed stump, amply covered by non-adherent and moveable soft parts, should not in this operation bear pressure as well as the stump made in any other amputation. Bearing this in mind, we can the more readily understand why, when this combination obtains, division of the tendo Achillis fails to produce the desired results. The heel is brought down, as we have seen in Sir W. Fergusson's case, and the retraction is thus overcome; but the painful adherent cicatrix still remains, and hence the disappointment.

We are, however, scarcely justified in at once proceeding to the removal of the two bones (for amputation of the leg would be quite unjustifiable), even though division of the tendo Achillis had individually failed. I would propose, prior to such an extreme measure, that, in addition to the division of the tendo Achillis, a subcutaneous separation or detachment of the adherent cicatrix from the bone be performed, and that attachment be prevented by frequently moving the soft parts over the bone. By this means we may not only separate the adherent cicatrix from the bone, but remembering the dissection of Stanski, we may at the same time cut through the abnormal attachments of the tendons of the flexor longus pollicis, &c., to the anterior surface of the os calcis. I have never had the opportunity of putting this measure in practice in adherent and painful cicatrices following Chopart's operation, but I have done so in other cases, and with complete success.

The first instance was that of a lady between fifty and sixty years of age, to whom I was called in the year 1857, by the late Mr. Chapman, of Hounslow.

Mrs. B——, when thirty years of age, suffered from suppression of the catamenia, for which she was on several occasions bled in the leg. After the last bleeding pain occurred in the spot. The pain continued with increasing severity for three years, during which period she was seen by most of the first surgeons of the day. She next consulted the late Mr. Liston, who at once excised the painful spot. The wound healed, and she remained free from pain for several years, when it returned precisely in the same spot, and continued for several weeks very severe, and not relieved by treatment, although there was neither redness nor swelling. Another surgeon of great eminence was then consulted; he proposed to remove the cicatrix, and this was done with relief, which lasted sixteen months, when the pain returned. The cicatrix was again removed, but at the end of six months she was as bad as ever. Her sufferings at this time were so great that she was willing to undergo any operation which held out the probability of effecting a cure. She appeared quite worn out with pain and want of rest. On hearing the history of her case I was struck with the fact, that after the last two excisions she remained free from pain so long only as the resulting wounds were open and unhealed, but that directly the cicatrix was completed the pain returned; and when, upon examination of the part, I found that the cicatrix was adherent to the periosteum, and perfectly immovable, I concluded that her sufferings were due to this cause, and that they would not be alleviated so long as the parts remained in their then condition. I therefore proposed that the skin should be detached from the subjacent periosteum by subcutaneous division; that reunion should then be prevented by moving the skin backwards and forwards from day to day, so that the new skin of the cicatrix should be placed in the same position as that of the surrounding integument. This having been agreed to, on the 15th September, 1857, I detached the cicatrix from the bone, the part cut through being cartilaginous, and so hard as to require a sawing motion of the knife. Mr. Chapman, who attended the case subsequently, and carefully prevented re-adhesion, informed me, in 1859, that the patient was then in good health, and had remained perfectly free from pain during the two years since the operation.

The next case was that of a Mrs. H——, aged thirty, admitted into Charing-cross Hospital on November 30th, 1858. She had disease of the left knee-joint at ten years of age. At fourteen the knee, being much swollen and very painful, was punctured, and a considerable quantity of blood escaped, but no matter. At sixteen the catamenia first appeared; they left her for two years, and then returned with irregularity. At seventeen years of age she fell, and so injured her knee that she went into the Royal Free Hospital, where the leg was amputated. The stump healed rapidly, but accidentally falling on the floor she hurt the stump so much that it reopened, and the bone protruded through the wound, preventing its healing. The pain then became so intense that subsequently two inches of the bone were removed. After this she recovered, and remained well until the year 1854, when she felt as though the limb was entire—as if the blood was rushing to every part below the amputation, accompanied by great pain in the nerves. The pain gradually increased until it became so severe and unbearable that she begged me to amputate the leg higher up. Upon her admission (Nov. 1858) I found that the cicatrix at one point was tied down to the end of the bone by a dense band about three-quarters of an inch long, and that any pressure upon this part increased her sufferings to a great degree. The end of the nerve, enlarged into a considerable bulb, could easily be distinguished attached by this band to the bone also. I had in other cases dissected out these bulbs, but with so little success that I was led to doubt very much whether the suffering was so very dependent upon this cause as is usually supposed; whilst the result of the case just related induced me to hope that were the cicatrix released from the bone so as to permit of free movement, the patient would be relieved from her sufferings and spared a second amputation. I accordingly detached the cicatrix from the bone by subcutaneous incision; the connecting tissue being dense, like cartilage. The soft parts were moved gently over the bone for a short time every day until the wound was healed and all trace of tenderness had ceased. The result was most satisfactory, and she left the hospital perfectly cured two months afterwards.

The alteration in the stump was certainly surprising. Prior to the operation the bone covered by the cicatrix projected nearly half an inch, the surrounding skin being flabby and puckered in around it, and apparently devoid of fat; in point of fact, a conical stump was in process of formation. But when the patient left the hospital all signs ot this misfortune had vanished, and the integuments appeared to have again become furnished with fat as in other parts of the body. The face of the stump became moveable, soft, and full, and so thoroughly covered the end of the bone as not only to afford a good cushion, but entirely to dissipate all anxiety as to its projection. In proposing this subcutaneous section of the cicatrix I was prepared for the subsidence of pain, but I certainly did not anticipate the great improvement in the development and shape of the stump; and it may become a question of some interest, and one worthy of consideration, how far the adhesion of the cicatrix, and consequent drawing up of the neighbouring skin to the bone and periosteum, may conduce to the formation of a conical stump, so usually attributed to insufficiency of soft parts and undue muscular retraction.

I have recently had a second case of conical stump wherein the mischief appeared to follow a fall five years after the original amputation. The femur, covered with thin tense skin, projected an inch and a half beyond the surface of the stump, whilst the skin covering the end of the bone had ulcerated, causing great torture. Strong adhesive bands could be felt passing from the intermuscular cellular tissue to the periosteum. I pursued the same treatment as in the preceding case, and with the same satisfactory results.

To prevent the drawing-up of the heel by the unopposed action of the tendo Achillis, various methods have been recommended. Care in dressing, tenotomy of the tendon, cutting the extensors, mechanical appliances, &c., have each and all met with their supporters. The following three cases illustrate the successful results of a very ingenious method adopted by Mr. Delagarde, of Exeter, and for the particulars of which I am indebted to the kindness of that gentleman.

Case 1.—Emma C——, aged forty-six, residing at Dawlish, came under Mr. Delagarde's care, suffering from caries of the front row of tarsal bones, and of the second metatarsal bone. On May 14th, 1862, Mr. Delagarde performed Chopart's operation. The wound was closed by four twisted sutures and three silver-wire sutures alternately. The tendon of the tibialis anticus was transfixed by one of the wire sutures, and as the wound healed the tendon became firmly attached to the cicatrix.

June 10th.—Is quite well; flexion and extension of the ankle perfect; the tibialis anticus balancing the gastrocnemius.

She wears a well-fitting boot or shoe, and now (1866) walks, as she has done ever since the operation, as well as ever.

Case 2.—Robert B——, aged fourteen, residing at Tiverton, a lively, active boy, but of strumous habit, had caries of the second, third, and fourth metatarsal bones of his right foot. Mr. Delagarde contemplated saving the great toe, if possible, and the whole of the tarsal bones, and made the flaps with that intention; but he found the first row of tarsal bones, including the internal cuneiform, so much diseased that he converted the operation into Chopart's amputation by curtailing the proportion of the upper flap. The flaps were brought together by one twisted suture, the pin transfixing the tendon of the tibialis anticus, and by interrupted sutures of silver wire.

The operation was performed on the 15th of June, 1865, and the stump had quite healed on the 25th of July. The power of flexion and extension was perfect.

Case 3.—William W——, aged thirteen, residing at Bridford. The front of his foot had been cut off across the metatarsus by the knife of some agricultural machine. He was taken to the Exeter Hospital, and the operation was performed on the same night, June 29th, 1865. Mr. Delagarde had some difficulty in making the flaps, as there was scarcely skin enough for Chopart's operation. The tendon of the tibialis anticus was separated from its attachment, transfixed by a pin, and secured by a twisted suture. The part of the tendon beyond the pin was laid under the edges of the skin, which were united by interrupted sutures of silver wire.

Aug. 10th.—Quite well. The tibialis anticus quite equal to its work.

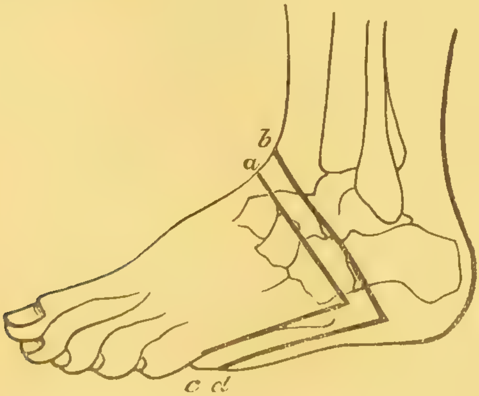
With reference to these cases, Mr. Delagarde remarks: "I think this treatment meets the grand objection to Chopart's otherwise admirable operation. In these three cases the tendon of the tibialis anticus became so connected with the cicatrix that its antagonism to the large extensor was thoroughly preserved. The tendon of the peroneus tertius might be similarly treated, but I think it unnecessary. The twisted sutures were only just sufficiently tight to bring the cut edges into apposition, so as to cover the tendons. The interrupted suture was inserted on each side close to the pin, so as to support the parts when the pin was removed."

Mr. Delagarde also urges the importance of leaving the ends of the wound open, and enveloping the part in a bread-and-water poultice; whereby he considers he saves time, certainly constitutional disturbance. Be this as it may, he deserves the best thanks of the profession for the introduction of this ingenious plan of proceeding, the value of which is fully proved by the cases here narrated.

The principal objections to Chopart's amputation, however, arise from the sacrifice of the scaphoid bone and calcaneo-scaphoid ligament, and the consequent destruction of the ball and socket astragalo-scaphoid joint and support of the head of the astragalus, to which the rolling and twisting of the stump and retraction of the heel are mainly due. A careful examination of the recorded cases of Chopart's amputation has convinced me that in a very large majority the scaphoid bone has been removed, and the support of the head of the astragalus destroyed without the slightest necessity, and from this as well as from experience of several cases in my own practice, I would venture to urge that there are very few cases indeed to which Chopart's amputation can be applied in which either the whole of the scaphoid and cuboid bones, or a sufficient portion thereof, for the preservation of the calcaneo-scaphoid ligament and attachment of the tibialis posticus may not be insured.

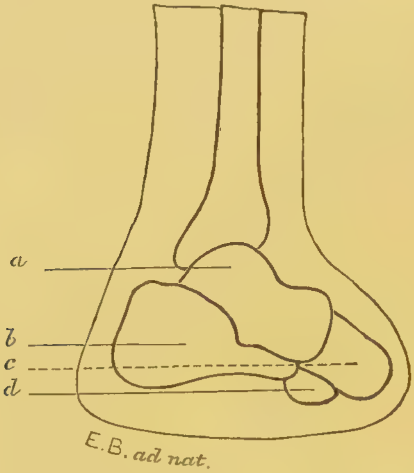
To effect this I have for several years past substituted the following operation for that of Chopart.

I feel for the prominence of the base of the fifth metatarsal bone, and carry an incision through the soft parts, commencing at the junction of the outer border of the foot with the sole, directly across the dorsum of the foot, from without inwards to where the inner border of the foot joins the sole in that direction. Arrived at this point, I turn my knife with its flat towards the bones and its sharp edge forwards, and cutting forwards well into the root of the toes, complete the lower flap. The dorsal incision passes over the dorsum of the cuboid about its middle, over the dorsum of the external cuneiform at about its anterior third, and falls upon the joint between the scaphoid and two internal cuneiform bones. By depressing the front of the foot the scapho cuneiform joints readily open, and if sound I complete the operation by sawing the cuboid across on a level with the most prominent portion of the scaphoid; if, on the contrary, the scapho cuneiform articulations show signs of disease I remove the articulating surface of the scaphoid, with a relative amount of the cuboid, and, after securing the vessels, complete the operation by subcutaneous section of the tendo Achillis. The annexed diagram shows the lines of incision in Chopart's operation and my modification.



(*b d*) Chopart's operation. (*a c*) My modification.

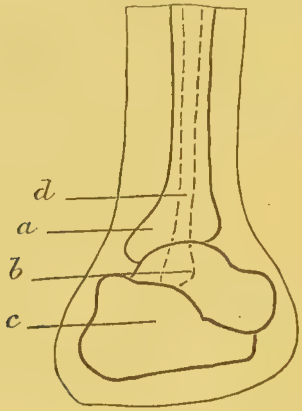
This converts Chopart's amputation into as perfect an operation as any performed on the foot; the resulting stump is excellent, the patient being able to walk, not only on level ground, but up ladders, without difficulty. A man upon whom I performed



SECTION OF STUMP AFTER MY MODIFICATION OF CHOPART'S AMPUTATION.

The fibula has been removed with the external malleolus, but the tibia is shown.

(*a*) Astragalus. (*b*) Os calcis. (*c*) Scaphoid. (*d*) Cuboid.



SECTION OF STUMP AFTER CHOPART'S AMPUTATION.

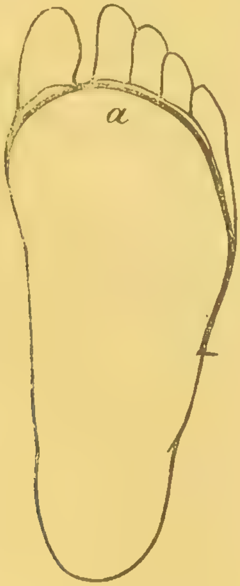
(*a*) Tibia. (*b*) Astragalus. (*c*) Os calcis. (*d*) Fibula.

this operation, whose business necessitated his working on ladders, told me he could get up and down as well as ever he could.

The annexed woodcut of a preparation in the museum of the Charing Cross Hospital shows the skeleton and shape of a stump of a patient upon whom I performed this operation seven years ago, and who recently died of pneumonia.

I am indebted to my friend and colleague, Mr. Bellamy, both for the preparation and drawing from which the woodcut has been engraved.

The following diagram shows the extent of the plantar flap anteriorly to the (*a*) root of the toes.



CHOPART.

British Surgeons.	Date.	Disease.	Sex.	Age.	Life	Results as to use of Limb.
James, Exeter	1828	Caries	M.	..	..	Good.
” ”	1848	”	F.	..	..	Doubtful.
Syme, Edinburgh	1829	6 cases	..	..	..	Good.
Roberts, Bangor	1833	..	..	..	..	”
” ”	1836	..	..	..	..	”
Miller	1840	..	..	..	..	
Liston	1842	Caries	F.	..	..	Good.
”	..	”	..	..	..	”
Garner, Stoke, Staffords.	1845	..	..	..	..	”
” ” ”	..	Both feet	M.	..	..	”
” ” ”	..	Caries	M.	..	..	Amputated.
Turner, Hanley	1846	”	M.	34	..	Good 2 months.
” ”	1856	Accident	M.	24	..	” 1 month.
Sir W. Fergusson	..	8 cases	..	..	2D.	6 good.
Phillips	1847	Caries	M.	18	..	Good 2 months.
Busk	..	8 cases	..	..	..	
Wakley	1848	Caries	..	..	..	Good.
Mead, Stockport	1849	”	F.	25	..	”
” ”	1854	”	F.	17	..	
Gore, Bath	1850	”	M.	22	..	Good.
Solly	1850	”	M.	43	..	”
Hancock	1851	”	M.	10	..	Retracted heel.
”	1851	”	F.	30	..	”
Cann, Hereford	1852	Frozen	M.	..	..	Good.
Monro, Moffat	1853	Accident	F.	..	..	” 2 months.
Ball	1854	Caries	M.	17	..	”
”	1856	Accident	M.	18	..	” 2 months.
S. Hey, Leeds	1854	2 cases caries	..	..	..	”
Barber, Sheffield	1855	Caries	M.	52	..	”
” ”	1855	”	M.	15	..	”
” ”	1857	”	M.	24	..	” 3 months.
” ”	1861	”	M.	..	..	” ”
” ”	1865	”	F.	..	..	” 7 weeks.
Jackson, Darlington	1855	Necrosis	M.	..	..	”
Livy, Bolton	1855	..	F.	50	..	”
O. Foster, Hitchin	1856	..	..	..	..	”
Hamilton, Dublin	1856	Caries	F.	20	..	”
Kemp, Exeter	1856	”	M.	18	..	”
” ”	1859	”	M.	22	..	”
” ”	..	Accident	M.	12	D.	14 days pyæmia.
Miller, Southsea	1856	Caries	..	..	..	Good.
Bryant	1857	Accident	F.	1½	D.	Convulsions.
Croskall, Dundee	1857	Caries	M.	22	..	Good.
Godfrey, Bristol	1857	”	F.	23	..	”
Hunter, Dublin	1857	Comp. disl.	M.	14	..	”
Hamilton, Liverpool	1857	Caries	M.	14	D.	Pyæmia.
Paget, Leicester	1857	Accident	M.	28	..	Good.

British Surgeons.	Date.	Disease.	Sex.	Age.	Life	Results as to use of Limb.
J. C. Lansdown, Bristol . .	1858	. . . .	F.	26	. .	Good.
Thornall, Bedford	1858	Railway accident . .	M.	. .	. .	"
" "	1858	"	M.	. .	. .	"
Cook	1859	Talipes . .	F.	aged	. .	"
Fearn, Derby	1859	. . . .	M.	19	. .	"
Gisborne, Derby	1859	. . . .	M.	. .	. .	"
Hey, Leeds	1859	Accident . .	M.	27	. .	"
Lestourgeon, Cambridge . .	1859	"	M.	50	. .	"
Macauley, Leicester	1859	"	M.	30	. .	"
Mann, Sheffield	1859	"	M.	37	. .	"
Parker, Birmingham . .	1859	Caries . .	M.	16	. .	"
Smith, Leeds	1859	"	F.	24	. .	"
Ashdown, Northampton . .	1860	Accident . .	F.	42	. .	"
Gascoyne	1860	"	M.	24	. .	"
"	1865	Caries . .	M.	17	. .	"
Meade, Bradford	1860	. . . .	. .	. .	. .	"
Folker, Hanley	1861	Caries . .	M.	15	. .	" 2 months
South	1861	Accident . .	M.	26	. .	"
"	1862	"	M.	26	. .	"
"	1862	Caries . .	M.	23	. .	Good.
"	1862	" . .	M.	29	. .	"
Walker	1861	" . .	F.	37	. .	
Clarke	1862	" . .	M.	23	. .	"
"	1862	Accident . .	M.	30	. .	"
"	1864	Caries . .	M.	24	. .	"
Delagarde, Exeter	1862	" . .	F.	46	. .	"
" "	1865	" . .	M.	14	. .	"
" "	1865	" . .	M.	13	. .	" 6 weeks.
C. Forster	1862	Cancer . .	F.	. .	. .	"
James, jun., Exeter	1862	. . . .	. .	. .	. .	"
Crompton, Birmingham . .	1864	Caries . .	M.	57	. .	"
Mash, Northampton . .	1864	Ry. accid. both feet.	M.	18	D	Pyæmia.
Richards, Stockport	1864	Comp. fract.	M.	29	. .	
Walker, Peterborough . .	1864	Ry. accid.	M.	. .	. .	Good.
Norman, Southsea	1865	. . . .	F.	4	. .	"
Walsh, Worcester	1865	Ry. accid.	M.	22	. .	"
Lane	. .	. . . .	. .	. .	. .	"
Lowdell, Brighton	. .	Accident . .	. .	. .	. .	
Moore	. .	4 cases . .	. .	. .	. .	Good.
Page, Cambridge	. .	. . . .	. .	. .	. .	"
Wilkins, Salisbury	1867	Perforating	M.	. .	. .	"
J. Birkett	1868	Caries . .	M.	28	. .	"

CHOPART.

Foreign Surgeons.	Date.	Disease.	Sex.	Age	Life	Results as to use of Foot.
Chopart	1791	Cancer ..	..	..	..	Good 3 months.
Pellatan	1798	..	..	..	..	,, ,,
M. A. Petit	1799	Accident	..	..	..	,, ,,
,,	..	Caries ..	..	..	D.	
,,	..	,,	..	..	..	Good
Dupuytren	..	..	..	..	..	
Boyer	..	Gunshot	..	..	..	Good 2 months.
Blandin						
Mungault						
Graeffe						
Walther						
Poultain						
Sedillot						
Soupart						
J. Syme, America	1836	Caries ..	F.	16	..	Good
Velpeau	1839	5 caries ..	..	..	1 D.	4 Good.
Textor	..	5 accident	..	..	2 D.	3 Good.
,,	..	7 caries	..	..	..	7 Good.
H. Larrey	1841	..	..	..	..	Retracted heel.
Nélaton	1842	..	..	..	..	,, ,,
Jobert	..	..	..	..	..	Amputated 2 years after.
Geoghegan, America	1847	Comp. fract.	M.	30	..	Good
J. Roux	1850	Caries ..	..	..	..	,,
Pirogoffe	..	5 caries ..	..	..	..	,,
Robert	..	2 accidents	..	..	1 D.	1 Good.
,,	..	2 caries ..	..	..	..	Good
Fouchier	1858	Comp. fract.	..	..	..	,,

LECTURE X.

ON RESECTION OF THE OS CALCIS.

Mr. President and Gentlemen,

Whilst the operation for complete resection of the os calcis was performed for the first time only thirty years ago, that for partial resection has been known for very nearly two centuries. We read in Riverius that, as far back as the year 1669, Formius excised a portion of the os calcis for the purpose of removing a musket-ball.

The first case of complete resection of the os calcis that I can find recorded was performed by M. Robert, of Prague, in the year 1837. He removed the entire os calcis for necrosis from a child, aged four years, by an incision along the outside of the foot. The child recovered so rapidly as to be able to walk in a month, and the bone is stated to have ultimately become almost completely regenerated.

The second case, but the first ever performed in this country, was operated upon by myself at the Charing Cross Hospital in May, 1848. The result was not satisfactory, as, after repeated attacks of erysipelas, I was obliged to amputate the limb.

This, in the short space of three weeks, was followed by the first successful operation of excision of the os calcis in England. It was performed in June, 1848, by Mr. Greenhow, of Newcastle; and two months afterwards, in August of the same year, Mr. Greenhow again excised the os calcis, and was equally successful; and on the 5th December, 1848, in the same year, Mr. Greenhow operated for the third time with equally good results. In 1852 Mr. Greenhow repeated the operation for the fourth time; but the case did not progress favourably, and he was obliged to amputate the limb on the 2nd November, when the astragalus, cuboid, scaphoid, and cuneiform bones were found to be carious.

On October 9th, 1848, Mr. Page excised the os calcis at the Cumberland Infirmary. "At the end of a year the patient found the foot as serviceable to him as the other."

Mr. Potter, of Newcastle, performed the same operation in two cases of caries: one in 1849, the next in 1851.

In the same year (1851) Mr. Gay removed the os calcis for caries at the Royal Free Hospital, and the patient recovered completely.

A case operated upon at St. Thomas's Hospital in 1851 by Mr. Simon did equally well, as did that of a girl, aged fourteen, operated upon by Mr. Lowe, of Congleton, also in 1851.

The success which attended these cases attracted the attention of surgeons in all directions—I may say in all countries. Mr. Hamilton imported the operation into Dublin in 1856. In 1857, Professor Carnochan introduced the operation at New York. Whilst in the same year, Mr. Atkinson, then residing at Jerusalem, excised the entire os calcis from Aboulafia, a Jewish rabbi of great distinction, who, during the Jewish feast of tabernacles, when in 1826 the city of Jerusalem was bombarded by the Egyptians, was wounded in his right heel by a fragment of a shell. After being confined to his bed for seven months, he so far recovered that for twenty-six years he enjoyed perfect use of his foot, visiting Europe, and frequently walking considerable distances. In 1853, a morbid growth sprang up by a pedicle from the os calcis. This was removed with a slice of the bone by Mr. Sim; but the disease reappeared, and resisted all applications and treatment for four years; consequently Mr. Atkinson removed the os calcis on the 1st of February, 1857. The patient progressed favourably; but the wound had not entirely healed at the date of his report, 15th March, 1857.

Surgeon Macleod excised the os calcis in the Crimea for a gunshot wound, and the patient recovered.

The operation has also been performed by Sir W. Fergusson, by Teale of Leeds, Humphry of Cambridge, Cann of Hereford, Pemberton of Birmingham, the two Lansdowns of Bristol, Folker of Hanley, Gibb of Newcastle, Lunn of Hull, Erichsen, Holmes, &c.

The younger Moreau, although aware of the frequency with which the tarsal bones require surgical interference, and the comparative ease with which they may be reached, certainly did not realize the value of this proceeding. "Caries of the heel bone," he observes, "is by no means promising. If its inferior surface be cut away, the heel can no longer support the weight of the body, and the patient is obliged to lean thereafter on the anterior part of the sole of the foot till he accustoms himself to the use of a high-heeled shoe. If the case be such that the tendo Achillis must be destroyed, it would be better to amputate the limb. I have performed this operation once only. I scooped out the whole inferior surface of the os calcis. I preserved the insertion of the tendo Achillis. The power of motion has been recovered, and a cure has been effected."

Lisfranc, though questioning whether a large portion of the posterior aspect of the os calcis might not be removed by cutting through the insertion of the tendo Achillis, adds, "that amputation is indispensable when the os calcis is too extensively carious."

Mr. Syme also lays down the rule: "If either the astragalus or os calcis be affected, of course the whole foot must be removed."

Liston's opinion was, that when the disease was not limited to the surface, excision of the tarsal bones "is not admissible."

Stromeyer records that "grazing shots, with exposure of the os calcis, require no operation, but heal readily under simple treatment; and that injuries of the tarsus generally are not very dangerous, and heal with unexpected facility, and without perceptible exfoliation, after extraction of the bullet." And he quotes a case wherein Dr. Frank removed a bullet from the tarsus which had been there for two years, and the patient did well.

"I am quite sure," writes Mr. Holmes, "if surgeons knew how useful a foot may be left after the excision of the calcaneum or astragalus, we should see less of amputation of the leg."

The late Mr. Teale wrote me: "The general result of these operations (excision of tarsal bones) has been very satisfactory. Indeed, I have adopted them as freely for disease limited to the posterior part of the foot as I have done Chopart's for the anterior part. There is, however, one condition necessary to the success of these operations—namely, that we select such cases of caries as are the result of pure, healthy (if I may say so) inflammation of ligaments, and not those which have originated in the cancellous structure of the bones, and which Sir B. Brodie attributed (as I think correctly, despite what is nowadays talked about strumous synovitis) to struma. In such cases, disease in one or two of the bones may have proceeded to abscess and caries; and when these bones are removed entire, the cartilaginous surfaces of the neighbouring bones may appear healthy, but the cancellous structure has probably begun to be softened, and the disease will most likely proceed, and render the operation abortive."

Dr. George Buchanan, of Glasgow, has kindly sent me the following notes on "excision of the os calcis." This operation has been so often performed that the attention of surgeons is directed solely to the cases suitable and to the mode of operation:—"*True* caries confined to the calcis is a rare thing. Circumscribed caries—often around a necrosed bit—admits of removal with a gouge; but more general, involving the whole bone, is rare, unless it involves adjoining bones; and this is true, even though the *intervening* joints and cartilages are *sound*. Let a surgeon who amputates through the ankle for disease of the astragalus (seemingly confined to that bone) make a longitudinal section of the foot with a saw, and in nine cases out of ten he will find incipient caries in adjoining bones, and the intervening joints sound. This I have very often proved; and this accounts for the frequency of return of caries after partial removal of the foot for caries. Hence, disease arising in the calcis from slight causes is always suspicious, and in the majority of cases requires amputation. But well-defined and *chronic* caries is a suitable case. Circumscribed necrosis of the os calcis can be managed as in other bones; but sometimes it is so extensive as to make excision the simplest and best procedure. There is a condition of the os calcis not seemingly much understood, which I venture to call progressive necrosis—namely, beginning at the posterior part (often as a consequence of a slight wound or injury) and creeping forward. The bone is denuded of periosteum, and is felt hard and gritty with the probe. In the first case I met with I sawed off the posterior third of the bone; but the wound did not heal entirely, and I found the anterior portion had passed into the same state. I then excised the remainder of the bone, and found, on section, the bone hard and evidently of low vitality, though not quite dead. In a subsequent case I excised at the very first, when I detected the above condition, and with a good result. Nearly the whole circumference of the bone was denuded of periosteum, and little exfoliations were coming off, leaving the bone below still rough and hard."

These notes are undoubtedly of great value, and merit our best attention; though I fear that, if implicitly followed, few cases of excision would ever be performed. I must confess that my experience is opposed to this doctrine; and I must also confess that I should pause long ere I amputated through the ankle for disease of the astragalus or calcis seemingly confined to those bones, unless there were other cogent reasons to urge me to do so independently of those manifested in the bone itself. It is better to be guided by the history, collateral circumstances, and symptoms combined, than to rely implicitly on symptoms and abstract principles alone, however judicious those abstract principles may seem to be. Take, for instance, a very ordinary example. A man sprains his ankle. He pays no attention to it at first, but continues his work. In due course of time, after inflammation, suppuration, the formation of sinus, &c., we discover by the probe that the astragalus is in a state of caries. The disease appears to be restricted to this bone. The disease is the only sign of struma manifested by the patient either in his own person or in his family history. Are we to throw the orignal cause of mischief, the general appearance of the patient, and the family history aside; and be governed only by the existence of caries, and the possibility that caries may be latent in other bones, and at once perform amputation without giving the patient a chance by the excision of the one bone of preserving the use of his foot? I can understand that some may consider it justifiable to at once having recourse to amputation, where the mischief has originated spontaneously without any assignable cause, when the constitutional taint of scrofula is generally apparent; but I cannot admit that caries *per se* is a sufficient justification for the undue sacrifice of a limb, even when occurring in a so-called scrofulous individual, especially if the exciting cause can be traced to injury, or that it is of itself a sufficient justification for abstaining from excision of the individual bone.

But let us turn to those cases wherein excision of the os calcis has been performed, and examine how far they support these opinions.

CASE 1.—R. W——, aged twenty-four, butcher; *strumous*. Admitted into Charing Cross Hospital May 12th, 1848, for caries of the right os calcis with abscess. His left leg had been amputated three years before for the same disease of the knee-joint. Being very anxious to save his remaining limb if possible, I, after consultation with Mr. Avery and Mr. Canton, excised the os calcis. The patient did well for the first four days, then erysipelas set in, and recurred from time to time, until the man's health began to give way, so that four months after the operation I was obliged to amputate his limb.

CASE 2.—H. H——, aged twenty, pitman; *scrofulous*. Admitted into Newcastle Infirmary under Mr. Greenhow, June 15th, 1848. Eight weeks before had a nail run into his left heel. Abscesses formed, and were opened, and one continued to discharge. The integuments were much swollen and indurated, and fluctuation could be felt below the outer ankle. The joint admitted of every motion.

August 15th.—The os calcis was excised. It was found to be extensively carious; the disease even extended across the articulating surface to the astragalus, a portion of which bone was also removed. Erysipelas attacked the limb repeatedly, and great care was required to get him through.

December 29th.—Is able to walk with only a slight halt.

Case 3.—T. B——, aged twenty-nine, pitman, of *scrofulous diathesis.* Admitted under the care of Mr. Greenhow, Aug. 10th, 1848, with disease of his left foot, principally affecting the os calcis, which could be felt through two fistulous openings. The disease commenced two years and a half ago with inflammation and abscess.

On August 15th a partial operation was performed. In a fortnight the wound was nearly healed, but erysipelas attacking it, excision of the whole os calcis was deemed necessary, and performed. The bone was carious in every part, except at one or two points of its articular surface.

October 17th.—Some slight sloughing of the integuments followed the operation, but the wound healed in due course, and on Feb. 10th, 1849, he left the hospital able to walk freely on crutches.

Case 4.—John R——, aged sixteen, a country lad, of *delicate and scrofulous appearance.* Admitted under the care of Mr. Greenhow, Nov. 30th, 1848, with disease of the foot principally affecting the os calcis, which was greatly enlarged and carious. One or two sinuses at the apex of the heel were found to penetrate deep into the bone. Ankle-joint moveable without much pain. The disease began eighteen weeks previously from excoriation of the heel occasioned by the friction of his shoe.

December 5th.—Os calcis excised, and diseased portions of the cuboid bone also sawn off. The calcaneum was one mass of diseased bone; its shape was hardly to be recognized, so far had caries destroyed it. The patient had many severe attacks of erysipelas, but he subsequently walked freely about on his foot, and when seen, seven years afterwards, was using it as perfectly as could be desired. He ultimately died of phthisis.

Case 5.—A. L——, aged twenty-nine, glass-maker, of *scrofulous diathesis.* Admitted under the care of Mr. Greenhow, May 13th, 1852, with disease of right ankle of seven months' duration, and following an attack of erysipelas.

May 18*th.*—The os calcis was removed, and found to be in an advanced stage of caries. This case did not progress favourably. The wound reopened, and on Nov. 2nd amputation was performed. The astragalus, cuboid, scaphoid, and cuneiform bones were all carious.

Case 6.—W. G——, aged sixteen, *unhealthy*, *ill-nourished*, *scrofulous.* Admitted into Cumberland Infirmary under the care of Mr. Page, July 29th, 1848, with disease of right tarsus, the result of a slight injury he had received several years before. Suppuration and ulceration commenced only six months ago, since which time he has been unable to put his foot to the ground. The disease appeared to be confined to the os calcis, into which a probe could be passed at two distinct points.

October 9*th.*—Os calcis excised. Astragalus and cuboid quite healthy. Inflammation of the tarsal joints retarded the cure, but at the end of a year he found it, "for all the uses of a foot, as serviceable to him as the other."

Case 7.—Thos. C——, aged fifteen, tailor, admitted into the Newcastle Infirmary, under the care of Mr. Potter, May 31st, 1849. He had been in bad health for two years, and had, he supposed, injured his heel by a tight shoe.

On the 3rd of July Mr. Potter excised the os calcis. The patient was seen in October, 1850, and had then just walked six miles without inconvenience.

Case 8.—H. C——, aged fifteen, of *scrofulous constitution*, admitted under Mr. Potter's care March, 1851. Five years before he sprained his foot; two years subsequently abscesses, followed by sinuses, formed round the ankle.

On March 11th Mr. Potter excised the os calcis. When seen some months afterwards a sinus remained, and the boy could not walk.

Case 9.—A house-painter, aged twenty-two, of *fair complexion, pallid, and scrofulous*, admitted into the Royal Free Hospital, under the care of Mr. Gay, in March, 1851. He had suffered from pain in the heel and foot for more than ten years. "Now, however, it was found that the os calcis was extensively diseased, the probe, passing through fistulous openings, coming into contact with dead bone."

On the 20th of March Mr. Gay removed the os calcis. "The articular surfaces were quite eroded, and the body of the bone was in places deeply carious." In six months the patient could walk well.

Case 10 is that of a boy, aged ten, operated upon by Mr. Simon, at St. Thomas's Hospital, on April 28th, 1851. He is described as of impaired health. The bone was found to be almost entirely necrosed. He was discharged cured on May 30th.

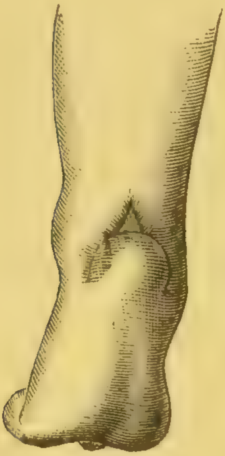
Case 11 is that of a red-haired, strumous mill girl, aged sixteen, operated on by Mr. Lowe, of Congleton, Dec. 12th, 1851. The patient had suffered for three years with disease of the left foot, which commenced with inflammation and swelling. The os calcis, when removed, was found to be in a carious condition, with the exception of a small portion on its outer side. The patient recovered completely; the wound had healed in less than two months, and she was able to walk without difficulty.

Mr. Pemberton, of Birmingham, has kindly sent me the particulars of the two following cases:—

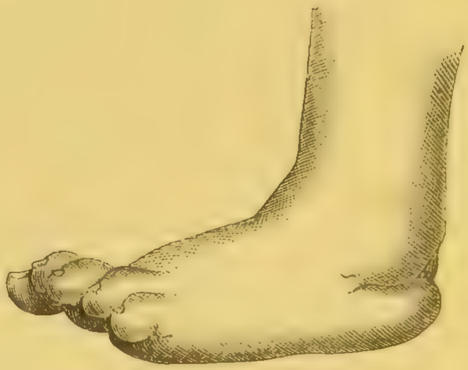
Case 12.—Jane D——, aged twenty-two, single, and healthy-looking, admitted under the care of Mr. Pemberton, at the General Hospital, July 28th, 1862. Fourteen years before she twisted her foot in a fall, and six weeks afterwards was again hurt in a similar way, and has continued to suffer ever since. On admission there was a large abscess over the outer aspect of the os calcis. The bone was extensively involved by advanced caries.

On Sept. 17th Mr. Pemberton excised the os calcis. The patient left the hospital cured on Nov. 17th. In a few months she cast away all assistance from crutch or stick; and on May 14th, 1866, Mr. Pemberton reports her to be well, strong, and able to walk with complete facility and comfort.

By the kindness of Mr. Pemberton I am enabled to give the following woodcuts:—A, representing the posterior view of J. D.'s foot after operation; and B, representing a lateral view of the same foot after operation.

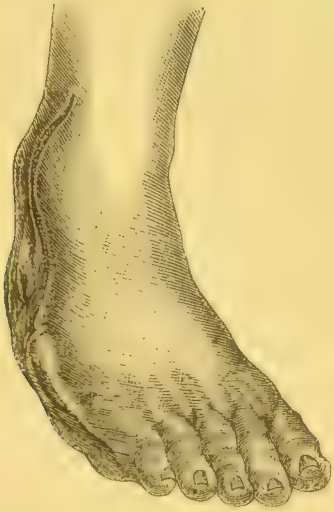


A

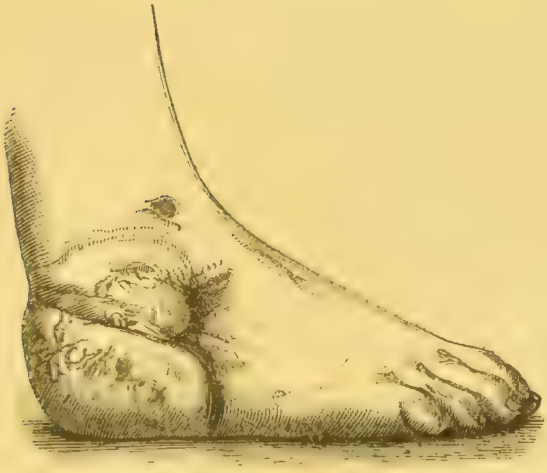


B

Case 13.—H. P——, aged twenty-nine, a strong, healthy, married woman, was admitted under Mr. Pemberton's care on Sept. 10th, 1861, on account of necrosis of right os calcis, the result of an injury received seven months previously. The patient urgently desired the removal of the foot, as she was entirely unable to walk, and as attempts made on a previous occasion to remove the diseased bone had failed to afford relief.



Appearance of foot after operation.



Foot after excision of the os calcis by Dr. Annandale, consulting surgeon to the Newcastle Infirmary. The patient made an excellent recovery.

On Sept. 28th Mr. Pemberton removed the os calcis. Six weeks afterwards she left the hospital on crutches. Mr. Pemberton remarks: "At the end of two years from the operation I am able to report that the wound is sound, and that she can walk any ordinary distance."

Mr. Holmes has also kindly furnished me with the particulars of the following four cases in which he excised the os calcis:—

Case 14.—Boy aged four years and a half, operated upon Nov. 2nd, 1861; discharged Feb. 3rd, 1862. Perfectly recovered. Can walk almost as well with one leg as the other, and can hop down a good-sized room on the foot operated upon.

When seen Jan. 30th, 1866, he could walk without any perceptible limp, and could point the toes to a considerable extent. Could run, dance, &c., as well as any other boy.

Case 15.—Boy aged five, operated upon July 5th, 1862; discharged Sept. 7th. The wound was healed, and the boy beginning to walk with ease.

Case 16.—Girl aged seven, operated upon May 14th, 1863; discharged, wound not healed, June 30th. Able to walk tolerably with an instrument.

This girl was seen in Feb., 1866. The limb operated upon is smaller and two inches shorter than the other, one inch of which is said to be due to atrophy of the tibia, the result, no doubt, of disuse preceding the operation. The foot is drawn somewhat upwards and inwards. She can walk with an apparatus, but cannot hop or stand for any length of time on that foot. The leg is also colder than the other.

Case 17.—A boy aged seven, operated upon by Mr. Holmes, on the 18th February, 1865. The wound was healing, though slowly, when he was attacked with diphtheria, of which he died March 23rd.

Mr. Holmes adds: "The operation was in all cases performed on account of extensive caries, accompanied in some by partial necrosis (so-called '*strumous disease*') of the os calcis. The operation consisted in the entire removal of the os calcis by the severance of all its ligaments. In the second case the lower surface of the astragalus was also removed with the chisel."

Case 18.—Mr. Mead, of Bradford, on March 12th, 1859, excised the entire os calcis from a gentleman, aged thirty, for caries. The disease appeared to be entirely confined to the bone, the articulating surfaces being healthy; but though the case went on well for a time, disease returned in the other tarsal bones, and he amputated at the lower third of the leg.

These eighteen cases controvert in no small degree the opinions which I have just quoted. In fourteen of these eighteen cases the patients are especially described as being scrofulous, two in impaired health, the remaining two only as healthy at the time of operation.

Of the fourteen the disease in eleven was entirely constitutional; in one it is said to have originated from a nail having run into the heel, and in two to have followed sprains.

Of these eleven three suffered secondary amputation, one on account of erysipelas, the other two from recurrence of disease in the remaining tarsal bones. One died of diphtheria, which can scarcely be attributed to this operation in particular, and seven recovered the perfect use of the limb.

Of the remaining three, in which the exciting cause is stated to have been accident, two recovered completely, whilst the result of the third was doubtful.

I have thus accounted for fourteen out of the eighteen cases. The mischief in the two stated to have been of healthy constitutions originated from accident. In the two described as in impaired health it was idiopathic. The operation, however, was successful in all four.

When these facts are made known and duly considered, they will, I trust, be the means of removing the dread with which these operations have been hitherto regarded. Here we have eleven operations performed for caries of the os calcis, originating spontaneously in scrofulous individuals. In two only did the disease secondarily manifest itself in the other tarsal bones. In a third, it is true, amputation was necessitated from erysipelas, but what a case was this! The poor fellow had already lost one leg for caries of the knee-joint, and it was only at his earnest desire that I was induced to attempt the preservation of his remaining foot, so unpromising did the case appear. Although doing well until taken with diphtheria, I will pass over the fourth case, and only enumerate the remaining seven, or 70 per cent., wherein the patients recovered, not with the preservation of a foot only, but with the preservation of the proper functions of the foot, the patients being able to walk miles, and some, we are told, to hop, jump, run, &c.

These examples, be it remembered, are not selected because they were favourable—quite the reverse; they are selected because they were most unpromising for operation. For if the opinions which have prevailed are correct, what cases can be more unfavourable for operative procedure than those originating spontaneously in the tarsal bones of scrofulous individuals, or those in impaired health?

To consider the general results of complete excision of the os calcis, I have been enabled to collect the particulars of thirty-four cases. Of these twenty-five recovered completely, four suffered secondary amputation, one is reported as doing well, of three the result is not given, and one, though doing well as far as the operation was concerned, died of diphtheria. The cases recorded show that this operation has hitherto enjoyed a remarkable immunity from fatal results. In no single instance can we fairly assign death to its performance. We certainly cannot ascribe the case of diphtheria to it;

and as for the only other case I find recorded against it, who for one moment would be inclined to attribute to an operation a death from phthisis taking place seven years after that operation was performed, and seven years after the patient had not only recovered from the effects of the proceeding, but also recovered the proper functions of the part? The gravest result, therefore, has been secondary amputation. Four cases are reported against twenty-five recoveries, or 16 per cent.—a very strong argument indeed against the primary adoption of that proceeding. For whilst I would again point out that excision of the os calcis has in no single instance resulted in death, I quite concur in the views expressed by Mr. Holmes, "that if these operations relieve the patient from present suffering, and restore him to the ordinary duties of life, they may often be advisable, even though they expose him to considerable immediate danger, and, further, leave him in a situation from which relapse is very probable." If, however, such relapse is rare, the indications for the operation are strengthened, and the more so the more rare the relapse may be. Here I would remind you that of the eleven cases operated upon under conditions most obnoxious to relapse, that occurred only in two, or in 18 per cent. I would also remind you that excision of the os calcis is not a final or an irrevocable proceeding; it does not preclude, nor does it in any way diminish, the advantages or success of amputation when from relapse such proceeding is rendered necessary, as in no single instance, as far as I can find, has death occurred under such circumstances.

The following case, for which I am indebted to Mr. Delagarde, is to me most valuable and interesting, since, whilst it confirms what I have here asserted, it at the same time shows what surgery may effect even under the most unpromising circumstances:—

"W. G——, aged thirty-five, residing in Exeter, was admitted into the Exeter Hospital, under the care of Mr. Delagarde, suffering from caries of the os calcis on the inner aspect, just in front of the posterior tuberosity, to be felt through a sinus. The physicians report that he has tubercles in the lungs, but strongly recommend an operation, and the patient is urgent.

"A curved incision was made behind the inner ankle, and a second incision towards the heel. The flaps above and below this last incision were dissected back. The concave face of the bone was then gouged out until the carious portion seemed totally removed. This operation was performed on May 12th, 1859. After a few hours, distressing pain came on. In a week a large abscess appeared below the outer ankle. This was opened with much relief. The wound healed; but other abscesses continued to form, and eventually the disease extended to the ankle-joint, the os calcis and astragalus becoming extensively carious.

"*May 3rd*, 1860.—The foot was removed by Syme's operation, but the lower flap was larger than usual. I dissected the os calcis out of the integuments, first from below, and afterwards, when the ankle-joint had been opened, from above. I had intended simply to have sawn off the malleoli, for the patient, who was a bootmaker, desired a very long stump for the boot he contemplated; but the extremity of the tibia was so soft that I sawed off the whole of the lower end both of that bone and of the fibula.

"I had great doubts as to the propriety of this operation," remarks Mr. Delagarde. "The lungs had been pronounced tuberculous, and he was excessively exhausted by pain and by purulent discharges; but I was again advised to operate by the physicians, and the patient settled the difficulty by requiring relief from pain, and any chance of life which could be afforded to him.

"He improved in health immediately after the operation, and the wound healed readily. I saw him two years after. He looked very phthisical, but had been able to maintain himself by his trade. I have just heard (1866) that he was seen six months since, and looked no worse."

Strongly, indeed, would I urge these facts upon those who still deny the utility of excision of the os calcis as a standard operation; who would still rather sacrifice a foot, which might thus be preserved and restored to a state little inferior to one of perfection.

And equally desirous am I that all honour should be awarded to him who, by his judicious and skilful proceedings, first established an operation so creditable to British surgery upon a sure and firm basis, and who thus conferred so valuable a boon upon mankind in general. I therefore propose that henceforth excision of the os calcis should be designated by British surgeons "Greenhow's operation."

In this, as in all other operations upon the foot, it is most important that the posterior as well as the anterior tibial artery should be preserved intact, if possible. When, therefore, we have reason to believe that the mischief is confined to the os calcis, the following procedure by Mr. Simon, in 1851, is the best. He made a longitudinal incision from above the heel to the centre of the sole of the foot; from this a second, at right angles, directly outwards round the external margin of the foot to its dorsum, the two cuts forming the outline of a rectangular flap. By reflecting this he immediately exposed the whole of the outer surface of the bone and its connections with the neighbouring bones. The os calcis easily turned out, as it was entirely necrosed, except at its cuboidal extremity, where a small portion was sound. Even the tendo Achillis was detached, with the periosteum. Unfortunately we have no information as to the after history of this case, or whether the os calcis was regenerated, beyond the announcement that the boy recovered in two months.

The plan recommended by Mr. T. Holmes is also very good. He makes two incisions at right angles down to the bone. One horizontal, on the supposed level of the junction between the astragalus and os calcis, starting at the inner border of the os calcis, dividing the tendo Achillis, and running forwards along the outside of the foot to midway between the heel and the projection of the fifth metatarsal bone, the situation, in fact, of the cubo-calcaneal joint. A second incision passes vertically across the sole of the foot, commencing near the anterior end of the first—that is to say, a little in front of the external malleolus, and terminating on the os calcis, near the inner edge. It is not prolonged into the grooved internal surface of the os calcis, in order not to wound the vessels. The flaps are then dissected back, and the joint between the calcis and cuboid opened.

When, on the other hand, we are doubtful as to the amount of mischief, when there is the chance of the disease proving so extensive as to necessitate the removal of the entire foot, the proceeding advised by Mr. Teale offers the greatest advantages. He makes a transverse incision across the sole of the foot, commencing about three-quarters of an inch in front of one malleolus, and ending at a similar point in front of the other. A second incision is then made in the median line, beginning over the tendo Achillis on a level with the ankle-joint, and joining the former at right angles in the sole of the foot. The two lateral flaps thus marked out being next dissected up close to the bones, the calcaneum and astragalus are thus freely exposed. By division of their ligamentous and tendinous connections one or both of these bones may be easily removed; and should it be thought desirable to remove also other bones of the tarsus, they may be readily reached by extending the median incision a little forwards. If, from the extent of the disease, it is found necessary to remove the entire foot, it may be accomplished by uniting the two extremities of the transverse incision by a curved incision across the dorsum of the foot.

In my own case I made a single semilunar flap in the sole of the foot, with the convexity looking forwards, with an incision from one malleolus to the other. I was induced to adopt this, being in doubt as to the extent of the mischief; but for excision of the os calcis solely, for the reasons stated above, I infinitely prefer Mr. Holmes's method.

In his first, second, and third cases Mr. Greenhow made incisions from the inner and outer ankles, meeting at the apex of the heel; then others along the apex of the foot, and dissected the flaps back, to expose the bone and its connections. A wedge of integument was removed in the first case, but it was found better to avoid this in the others. In the fourth case, an incision was commenced at the apex of the heel and carried upwards to the inner malleolus, and then downwards and forwards; and the same being repeated on the outer side, two curved flaps were formed.

Mr. Pemberton, on the other hand, in his first case made a horseshoe flap, by incisions along the sides of the foot and round the heel. In this course the knife cut deeply on the bones, and divided the attachment of the tendo Achillis. In his second case he pursued very nearly the same plan as that recommended by Mr. Holmes.

Dr. George Buchanan says the incisions are best made so as to leave the integuments and soft parts suitable for conversion into a proper covering for amputation, if the disease is found more extensive than anticipated; also to avoid the vessels and nerves of the foot. He therefore adopts the following plan:—Enter a strong knife at the external malleolus, carry it perpendicularly down to the outer edge of the foot, and continue it two-thirds across the sole, about an inch and a half in front of the heel. At right angles to this make an incision along the outer edge of the foot to a point a little in front of the calcaneo-cuboidal joint. The two angular flaps are to be dissected up till the external and inferior surfaces of the calcaneum are nearly exposed. The posterior flap can now be turned back over the projecting heel, and the tendo Achillis cut. By dividing the middle fasciculus of the external lateral ligament the bone can be twisted so as to expose the calcaneo-cuboidal articulation, which can be opened by the point of the knife, and the whole bone can be forcibly twisted inwards, the point of the knife dividing the interosseous ligaments as they are put upon the stretch. When the disarticulation is completed, the soft parts on the inner side can be separated without any risk of injury to the vessels or nerves.

Lieuhard dissected a foot in which he had excised the os calcis three years before. The sole of the foot was much flattened, and the prominence of the heel had disappeared. Beneath the skin there was a mass of very dense tissue, in which the tendo Achillis, the origin of the short flexors of the toes, the adductor pollicis and abductor minimi digiti, lost themselves. The cuboid was displaced slightly backwards, and was united by very strong fibrous bands with the neck of the astragalus. The whole foot was rotated inwards, as in valgus, and the displacement existed principally between the scaphoid and astragalus. The head of the latter was turned almost directly towards the sole of the foot.

This confirms the account given by Wagner, that the examination during life of persons who have recovered after extirpation of short bones, shows that the defect has been remedied as far as possible by the approximation of the bones which lie nearest together. The interval which is left seems to be filled up by a ligamentous material, in which, masses of cartilage or bone are sometimes deposited.

Sir W. Fergusson, in a case in which he amputated at the tibio-tarsal joint seven years after he had extirpated the inner half of the os calcis for caries, found the bone partly regenerated, and the place of the lost substance partly occupied by a fibro-cartilaginous material.

Giving insertion to the strong tendo Achillis, exposed also to all the shocks and injuries which may assault the foot, we cannot be surprised that the os calcis is liable to fracture from muscular contraction as well as from other causes.

Mr. Holmes Coote kindly writes me that there is in the museum of St. Bartholomew's Hospital a preparation of fracture of the upper part of the os calcis from muscular contraction, and that he had at the time of writing a similar case under his care, in which the patient, a respectable woman at Woodford, walked a quarter of a mile after the accident to get to the hospital. Here the upper fragment was completely detached.

Mr. Henry Smith saved the foot in a case of compound comminuted fracture from explosion. The os calcis was broken to pieces. As many fragments as possible were removed at the time, and the patient recovered, being able to walk.

A collier, aged fifty-four, was admitted, under the care of Mr. Folker, into the North Staffordshire Infirmary on the 21st October, 1862, with fracture of the os calcis. The accident was caused by a fall of a stone on the heel. The bone was broken through, and drawn up by the tendo Achillis. He had been under treatment elsewhere for about a week. It was found impossible to reduce the fractured portion, so it was removed. The parts healed slowly, but the man was discharged cured on Dec. 15th. Mr. Folker has since heard that he walks very well.

I am indebted for the following case to the kindness of Mr. Wheelhouse, of Leeds:—

Eli Sykes, aged nineteen, confined in Leeds borough gaol, had been sentenced to death on December 9th, 1865, for the wilful murder of Hannah Brooke, at Batley, on August 19th. His demeanour after sentence seemed calm and resigned. He was confined in a cell on the ground floor for the first day; but as another condemned prisoner seemed not so trustworthy, the latter was put into it, and Sykes removed to one on the first gallery. About a quarter before seven on December 23rd, the door of his cell being accidentally unfastened, he got out, ran along the first gallery to the staircase and up to the top landing, threw himself over the rails, and fell on the stone floor beneath, a distance of over twenty feet. He appears to have dropped, rather than jumped from the rails; to have alighted on his feet, and then fallen forwards, striking his forehead against the ground. When seen by Mr. Price, surgeon to the gaol, both ankles were much swollen; and at the inside of the left was a wound about the size of a shilling, through which loose portions of bone could be felt, and from which there was free arterial hæmorrhage. There was also free oozing from a wound in the sole of the right foot. Both tibia and fibula appeared uninjured. At ten p.m., Mr. Wheelhouse saw him in consultation, and removed large fragments of the os calcis by means of a crucial incision over the left ankle, which disclosed extensive comminution of the os calcis; and there was free arterial bleeding from the bottom of the wound, for which two ligatures were applied. It was found that he had also sustained a fracture of the skull over the frontal sinus. On December 26th his pulse was 140; the wound in the ankle looking well. On the 30th he became delirious, and so violent as to require restraint. On January 3rd secondary hæmorrhage commenced from the left ankle; it was easily arrested at the time, but recurred briskly in the evening, leaving him very weak. He rallied; but on the 6th the hæmorrhage again returned, and, though not profuse, was sufficient to destroy him: he gradually sank, and died five hours afterwards, being conscious to within an hour of his death.

Autopsy, forty-two hours after death.—Spare frame; ecchymosis of forehead and left elbow and shoulder. In the left foot was a compound comminuted fracture of the os calcis, which was broken into numerous pieces, the astragalus being twisted and drawn down among them. There was considerable infiltration of the tissues, which were sloughy. The plantar arteries had been wounded just after the division of the posterior tibial. The source of bleeding in the central and anterior part of the wound could not be made out, as the arteries were lost in the sloughy part of the wound. In the right foot the os calcis was fractured, though not nearly to the same extent as the left, the wound in the sole communicating with the fracture. There was no extravasation of blood, and healthy suppuration was going on.

COMPLETE EXCISION OF OS CALCIS.

British Surgeons.	Date.	Disease.	Sex.	Age.	Life	Results as to use of Limb.
Hancock	May 1848	Caries ..	M.	..	..	Amputated.
Greenhow, Newcastle ..	Aug. 1848	” ..	M.	20	..	Good, 14 weeks.
” ” ..	1848	” ..	M.	29	..	” 6 months.
” ” ..	1848	” ..	M.	16	..	” ”
” ” ..	1852	” ..	M.	29	..	Amputated 6 mo.
Page, Carlisle	1848	” ..	M.	16	..	” 3 months.
Potter, Newcastle	1849	” ..	M.	15	..	Good, 2 months.
” ”	1851	” ..	M.	15	..	Doubtful.
Gay	1851	” ..	M.	22	..	Good, 2 months.
Simon	1851	” ..	M.	10	..	” ”
Lowe, Congleton	1851	” ..	F.	16	..	” ”
J. P. Lansdown, Bristol	1851	” ..	..	..	..	”
J. C. Lansdown, Bristol	1852	” ..	F.	14	..	”
Field, Margate	1852	” ..	..	..	..	”
Macleod	1853	Gunshot ..	M.	..	..	”
Carn, Hereford	1854	Caries ..	M.	32	..	”
Teale, Leeds	1855	” ..	F.	35	..	”
” ”	1855	” ..	M.	12	..	Amputated.
Hamilton, Dublin	1856	” ..	M.	54	..	
Coe, Bristol	1856	” ..	M.	19	..	Good.
Gibb, Newcastle	1856	” ..	..	..	..	”
Lunn, Hull	1856	” ..	M.	15	..	”
Atkinson, Smyrna	1857	” ..	M.	54	..	”
Erichsen	1858	” ..	F.	5	..	”
Husband, York	1859	” ..	F.	24	..	Doubtful.
Holmes	1861	” ..	M.	4	..	Good, 2 months.
”	1862	” ..	M.	5	..	” ”
”	1863	” ..	F.	7	..	” 6 weeks.
”	1865	” ..	M.	7	D.	Diphtheria.
Folker, Hanley	1862	Accident ..	M.	54	..	Good, 2 months.
Humphrey, Cambridge	1863	Caries ..	F.	7	..	” ”
Meade, Bradford	1859	” ..	M.	30	..	Amputated.
Pemberton, Birmingham	1861	Necrosis ..	F.	29	..	Good.
” ”	1862	Caries ..	F.	22	..	”
E. Canton	1868	” ..	F.	16	..	”
V. Jackson, Wolverhampton	1869	” ..	F.	19	..	”
Simpson, Lincoln	1871	” ..	M.	9	..	”
Annandale, Cumberland	..	.. ..	..	..	..	”

PARTIAL EXCISION OF OS CALCIS.

Whether from its greater size, its greater number of points of ossification, or its similarity to the long bones in possessing an epiphysis, the os calcis would seem to admit of partial excision being performed upon it for disease with much greater prospect of success than any other bone of the tarsus. From the cases recorded, it is evidently more frequently the seat of disease than the rest; and from the nature of the cases recorded, it is an exception to the laws of pathology as enunciated by Wagner in his celebrated treatise "On the Reproduction of Bone." Speaking of resection of the os calcis, he observes: "The power of regeneration of short bones is usually placed far beneath that of the tubular bones; but with respect to the regeneration after resection of the extremities of the long bones, the difference cannot *à priori* be assumed to be very considerable. The articular ends of long bones are hardly distinguishable in anatomical structure from the short bones. Even the periosteum which covers the short bones is wanting in a portion of the others; and the difference can *à priori* be founded only on this consideration—whether in resection of the long or tubular bones the shaft is *more* or *less* involved in the operative procedure. That this *à priori* conclusion is correct is shown by experience. Necrosis most usually attacks the shaft, seldom the extremities of the bones.

Mr. Erichsen also, whilst admitting that the os calcis is the most frequently diseased of the tarsal bones, adds that "this is by caries, not necrosis, the latter occurring but rarely." Dr. George Buchanan, on the other hand, says that true caries confined to the os calcis is a rare thing. Circumscribed caries, often round a necrosed bit, admits of removal by gouge, &c.

We have already seen that necrosis of the ends of the long bones is by no means so uncommon as implied by Wagner's observations. It has been met with, and not unfrequently, in the extremities of all long bones; nor is it so unusual in the os calcis. We have seen it in the interesting case recorded by Mr. Cæsar Hawkins; we also find it in the following cases:—

Mr. Wheelhouse, of Leeds, removed a sequestrum from the os calcis in February, 1866, leaving a smooth cavity. The case was progressing favourably when he wrote.

In another case a sequestrum was removed from the left os calcis. The disease had existed for four years. Cause unknown. A piece of dead bone was removed, which was found lying in a smooth granulating cavity.

Mr. Power, in August, 1866, kindly sent me a patient who had applied to him at the Westminster Hospital for a wound on the inner side of the heel. He had been operated upon for necrosis of the os calcis in 1861.

Mr. Liston, in 1844, applied the trephine and removed a sequestrum, the size of a small nutmeg, from the os calcis of a girl aged seventeen, who had suffered for three years and a-half. The patient recovered, and left the hospital three months after the operation. Mr. Liston also removed a sequestrum from the inner side of the os calcis by applying the trephine in the case of a girl aged ten years. She recovered completely; as did a woman, aged thirty-two, from whose os calcis Mr. Solly removed a sequestrum in June, 1853.

Mr. Samuel Hey, of Leeds, removed a sequestrum from the os calcis. He was subsequently obliged to amputate the leg, and the patient recovered.

Although, as a general rule, I quite agree with Mr. Holmes in the conviction of the great advantage of complete excision of the tarsal bones over gouging, still many cases are recorded in which success has attended partial resection of the os calcis for caries even when effected by the gouge, especially when the periosteum has been preserved.

W. W——, aged twelve years, was admitted into King's Lynn Hospital, under the care of Mr. Kendall, with caries of the os calcis, from which he had suffered for some months. Constitutional treatment having failed, he, on the 7th of May, 1866, was placed under the influence of chloroform, and on examination it was found that the greater portion of the os calcis was diseased. This was gouged out, the periosteum being left; and the wound was dressed with a solution of chloride of lime, thirty grains to the ounce. The cavity filled up with bone extremely fast, and on the 23rd of June, forty-seven days after the operation, he left the hospital quite well, and is now at work.

W. A——, aged twenty-eight, residing at Swaffham, was admitted into the West Norfolk Hospital, under Mr. Kendall's care, March 17th, 1866, with extensive disease of the os calcis and astragalus. There were several sinuses leading down to and opening into the joint, which had existed for more than a year. As constitutional treatment had failed, Mr. Kendall, on the 11th of June, gouged away the greater part of the os calcis and the front of the astragalus, leaving the periosteum untouched as far as possible. The wound was dressed with the solution of chloride of lime. The patient did very well, and on the 4th of August he was made an out-patient, but was ordered not to rest any weight upon the limb for the present.

The late Mr. W. James, of Exeter, operated upon T. C——, aged eighteen, on the 26th of April, 1860. The operation consisted in turning back a flap, and gouging out part of the os calcis; then bringing back the flap, which united, and the patient recovered. Mr. James, sen., kindly wrote me, on the 19th February, "I had great pleasure in hearing that in the case of excision of the os calcis operated upon by my late son, the patient is now in India, serving in the English navy."

I am indebted for the following case to the kindness of Mr. C. Williams, of Norwich:—A farm-boy, aged eighteen, about six months before admission into the Norwich Hospital, suffered deep-seated pain in the outer ankle of his left foot. A few weeks later an abscess formed in that situation, and shortly after several more formed around the heel, so that on admission there existed several orifices on either side of the calcaneum, leading to sinuses, through which carious bone could be detected, and a rather profuse discharge of unhealthy pus was issuing therefrom. The ankle-joint seemed free from disease. An incision was made from below one malleolus round the sole of the foot to a similar point on the opposite side, and this was intersected by an incision along the middle of the heel. About three-fourths of the os calcis was then exposed and sawn off. No joint was interfered with. The case progressed most favourably, and he was dismissed cured six weeks after. Mr. Williams had the opportunity of seeing this case almost a year later. The patient had then a capital heel, and could walk well.

PARTIAL NECROSIS OF OS CALCIS.

M. S——, a dark healthy-looking child, aged six, admitted with a small opening on the outer side of the right heel, which had been discharging slightly for several months, and was found to communicate with a sequestrum in the centre of the os calcis.

On the 20th January, 1872, I made a semilunar incision over the outside of the os calcis and reflecting the flap upwards, with a gouge enlarged the opening in the outer shell of bone, and evacuated the sequestrum, leaving a cavity about the size of a small walnut. The limb was then placed on a back splint with foot-piece, and the wound covered with folds of lint soaked in a solution of carbolic acid (one part to sixty of water). The lint was subsequently kept continually saturated with the same lotion by means of a bottle-syphon, and the dressings were removed for the first time on February 24th, when the cavity in the bone was filled by firm dense tissue, and the flap adhered to the bone, a line of granulation, half-an-inch wide, marking the course of the incision. The child left the hospital, cured, fourteen weeks after the operation, having walked about the ward for a fortnight previously.

The annexed table gives the particulars of 43 cases of partial excision of the os calcis, although doubtless many more have been done. Of these, 25 were performed for caries, 1 for necrosis, 13 for necrosis with sequestra, 4 for accidents.

Of the 25 for caries, 14 recovered at periods varying from six weeks to six months; 2 required a second operation, but recovered; 1 suffered secondary amputation; 1 died the day after the operation, of diarrhœa; of 7 the result is not given.

The subject of necrosis recovered.

Of the 12 patients suffering from necrosis with sequestra, 4 recovered; 1 required a second operation; 1 suffered secondary amputation; in 7 the result is not given.

Of the 4 patients operated on for accident, 3 recovered—one in seven weeks; 1 died in fifteen days.

PARTIAL EXCISION OF OS CALCIS.

British Surgeons.	Date.	Disease.	Sex.	Age.	Life	Results as to use of Limb.
Hey, Leeds						
Liston	1844	Sequestrum	F.	17	..	Good.
"	1844	"	F.	10	..	"
Holt	1850	Caries	M.	18	..	"
Solly	1853	Sequestrum	F.	32	..	"
Hilton	1855	Caries	M.	..	..	"
"	1854	Sequestrum				
Birkett	1854	"				
Statham	1854					
Adams	1854					
Hancock	1854	Caries	..	..	..	"
Stanley	1855	Sequestrum				
Long, Liverpool	1857	Caries	F.	22	..	Doubtful.
Hey, York	1857	"	M.	12	..	Good.
Johnson, Derby	1857	"	M.	19	..	"
Curling	1857	"	M.	12		
Lane	1857	"	M.	33		
Fearn, Derby	1859	"	M.	21	..	"
Gisborne, Derby	1859	"	M.	18	..	"
Page, Carlisle	1859	"	M.			
Meade, Bradford	1859	"	M.	30	..	Amputated.
S. Hey, Leeds	1860	Sequestrum	..	..	..	Good.
W. James, Exeter	1860	"	M.	18	..	"
Delagarde, Exeter	1859	Caries	M.	35	..	"
" "	1861	"	M.	60	..	Fair.
Magrath, Teignmouth	1862	Ry. Accid.	M.	16	..	Good.
Shillito, Hitchin	1863	Caries	M.	15	..	" 3 months.
Walsh, Worcester	1864	Ry. Accid.	M.	35	..	" 7 weeks.
H. Smith	1864	Explosion	M.	..	..	"
Garner, Stoke	..	Sequestrum	..	..	..	"
Rowe, Margate	1865	Caries	M.	22	..	"
Wheelhouse, Leeds	1866	Necrosis	..	..	..	"
" "	1866	Ry. Accid.	..	..	D.	15 days.
Spack, North Staffordshire	..	Caries	..	..	D.	Next day.
Curling, Margate	1861	Necrosis	..	..	..	Doubtful.
Kendall, Lynn	1866	Caries	M.	12	..	Good, 7 weeks.
" "	1866	"	M.	28	..	"
C. Williams, Norwich	..	"	M.	18	..	"
Gore, Bath	..	"	M.	14	..	"
Hancock	1872	Necrosis	F.	6	..	Good, 14 weeks.

APPENDIX.

APPENDIX.

Resection of the Os Calcis and Astragalus was first performed by Mr. T. Wakley, in the year 1847. (See Lecture VII.)

CASE 2.—In the year 1855, Mr. Barnard Ring, of Stratford-on-Avon, removed the os calcis and astragalus from a girl, aged thirteen, for caries of long duration, taking the description of Mr. Wakley's operation as his guide.

The patient was kept under observation till February, 1856, when she was discharged, supplied with an iron support to wear for a time.

A year or two afterwards she presented herself quite well, and was directed to lay aside the instrument and present herself again in twelve months, but she died of fever in the interim.

CASE 3.—Heyfelder, on the 17th December, 1858, extirpated the os calcis and astragalus from a youth, aged seventeen, for caries resulting from a sprain.

He made an incision from the tendo Achillis to the middle of the instep, passing below the external malleolus, and a second from the centre of the sole of the foot to meet the latter at right angles. He then removed the bones. The operation did not succeed. He amputated the limb on the twenty-fourth day, and the patient recovered.

Case 4.—Dr. Macleod, during the Crimean war, removed the os calcis and part of the astragalus. The patient recovered.

Case 5.—Mulvaney, Canada West, October, 1866, removed both malleoli with a quarter of an inch of tibia, the astragalus, half the os calcis, and three-quarters of the scaphoid bone, for accident, in a man aged twenty-nine; and the patient recovered with motion.

Partial resection of the Calcis, Astragalus, and Scaphoid Bones.

Severin, as early as the year 1646, resected portions from the os calcis, astragalus, and scaphoid bones with a red-hot knife. The patient recovered.

Resection of the Calcis, Astragalus, and Cuboid Bones.

The late Mr. Teale, of Leeds, performed this operation upon Aquila Megson, aged twenty-four. At the end of nine months he walked about with the assistance of a stick, one or two fistulæ discharging a little synovia existing at that time. He died three years afterwards of phthisis.

Partial Resection of the Calcis, Astragalus, and Cuboid Bones.

In the year 1751, Durand removed portions of the os calcis, astragalus, and cuboid bones. The patient recovered.

Resection of the Calcis, Astragalus, Scaphoid, and Cuboid Bones.

This extraordinary operation was performed by the late Mr. Teale, on the 1st of May, 1855, upon Eliza Kelly, aged twenty-two.

This patient returned to her duties as a domestic servant, and, in 1866, was engaged in making clothes by the sewing-machine. When she has much walking she uses a stick, otherwise she walks without assistance.

Resection of Astragalus and Scaphoid Bones.

In the year 1832, Jaeger removed these bones for caries, but the result of his case is doubtful. The only other instance that I am aware of, in which this operation has been performed, is that in which Mr. Holmes removed the astragalus and scaphoid bones from a girl, aged nine, for caries and ankylosis, with very good result.

Resection of the Astragalus, Scaphoid, and Cuneiform Bones.

In the year 1821, the late Mr. Liston performed this operation.

Resection of the Os Scaphoides.

It has been laid down by an author on surgery, that the scaphoid bone stands next to the astragalus in its power of implicating other bones. "Disease of this bone may pass backwards to the astragalus, or forwards, implicating the whole of the anterior synovial membranes. The same author has never heard of resection of the scaphoid bone having been done, and he would imagine that if it were excised, complete disorganization of the foot would ensue. In these cases Chopart's amputation is the only resource." How far this opinion is correct the following cases will show:—

Case 1.—In the year 1859, Professor Humphry excised the whole of the scaphoid and a portion of the cuboid bones from a boy, aged six years, for caries. The patient recovered in four months.

Case 2.—Mr. Hilton, in the year 1857, excised the scaphoid and half the adjoining metatarsal bone from a lad, aged eighteen, for caries; the internal cuneiform bone had been removed four years previously.

Case 3.—Mr. Wright, of Cheltenham, successfully excised the scaphoid, three cuneiform, and two metatarsal bones.

Boyer, in 1843, mentions that Schrauth excised the os scaphoides for caries, from a soldier, aged twenty-three. He made a crucial incision, but was afterwards obliged to tie the posterior tibial artery for secondary hæmorrhage. The patient recovered, and was able to resume his duties.

Paul also removed the scaphoid bone from an artisan, for caries, resulting from accident. The patient recovered.

Compound Dislocation of the Scaphoid Bone.

The following case was saved by Mr. Wheelhouse, of Leeds:—

J. H——, aged twenty, an engine-cleaner, on 9th June, 1864, had the misfortune to get his foot under the wheels of an engine, and was at once taken to the Infirmary at Leeds.

Mr. Wheelhouse found a severe crush and laceration of the right foot, extending from the inner malleolus to the great toe. The integuments and subjacent fascia were entirely separated from the muscles, many of which, and especially the abductor pollicis, were fully exposed. The finger could be passed from the ball of the toes very nearly to the heel, between the skin and the pulpified tissues underneath. The scaphoid bone was dislocated; the plantar vessels were not apparently injured, but there was considerable bleeding.

In consultation with the late Mr. Teale and Mr. Hey, it was thought there was a fair chance for recovery without amputation. The scaphoid bone, therefore, was reduced, the wound dressed with cold water, and the limb placed on a pillow.

Very little pain and constitutional irritation followed; there was some slight sloughing of the skin, but the patient did well, and was discharged cured on the 18th of the following August.

Dislocation of the Os Scaphoides and Cuneiform Bones.

I only find two cases recorded of this unusual accident. The first occurred in the practice of Mr. Godfrey, of Bristol; the second in that of the late Mr. Lonsdale.

Dislocation of the Scaphoid and Middle Cuneiform Bone of Right Foot.

Case 1.—A man, aged fifty, in the year 1851, fell from the roof of a house and alighted on his feet. Mr. Godfrey found the right foot much swollen. The scaphoid, partially dislocated, formed a prominence above the other bones. In front of this was another prominence, smaller, but rather higher than the other. By depressing the metatarsus and pressing upon the small prominence, it readily slipped into its place, and on reversing these actions, it as readily slipped out again. This was repeated upon several occasions, until at last the bone could not be displaced. The scaphoid was easily reduced.

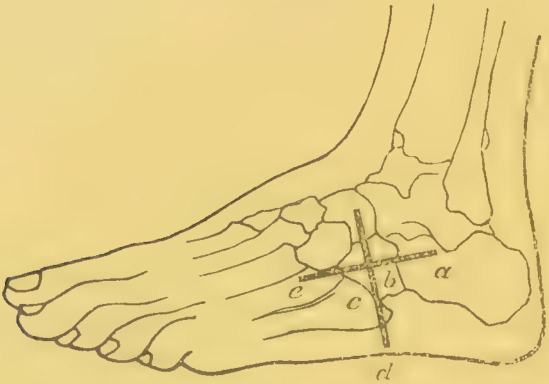
Dislocation of the Scaphoid and Internal Cuneiform Bones.

Case 2.—A young man, aged twenty, was riding a pony, when the latter fell upon his foot.

When Mr. Lonsdale saw him some months afterwards, he found the scaphoid and internal cuneiform bones displaced and projecting inwards. A depression could be felt between the tibia and the projecting navicular bone, and the projection of the metatarsal bone of the great toe could be traced throughout its whole course; its junction with the internal cuneiform could be felt, but its base was much below the level of the latter. The foot was shorter than natural.

Excision of Cuboid Bone.

On 19th January, 1872, I removed the cuboid bone from J. H——, a dark, ruddy-looking youth, aged seventeen, who had always enjoyed good health, until nine months previously, when a small swelling appeared on the outer side of his left foot. This gradually increased for five months, when it broke and discharged a small quantity of pus. As the boy suffered considerable pain and could not follow his employment, I made a crucial incision and removed the cuboid bone, which was extensively diseased. The limb was then placed on a back-splint with foot-piece, and swung on a Salter's cradle. The wound was covered with a few folds of lint, soaked in a weak solution of carbolic acid (one part in sixty of water), and kept constantly saturated with the same solution by means of a bottle syphon suspended from the top of the cradle. The dressings were neither changed nor removed until the end of seven weeks after the operation, when the cavity, resulting from the removal of the bone, was filled by a dense structure, presenting a healthy granulating wound covered by a small secretion of pus. The patient left the hospital on the 26th of April, three months after the operation, perfectly cured.



SHOWING LINES OF INCISION FOR REMOVAL OF CUBOID.

a, Os calcis. *b*, Cuboid. *c*, *c*, Fourth and fifth metatarsal bones. *d*, Outer margin of sole of foot.

Resection of the Cuneiform Bones.

It is said that when the cuneiform bones are the seat of caries, it is generally the middle one which is primarily affected; that the disease then extends to the internal and external, and on to the basis of the second and third metatarsal bones; whilst, in such cases, the anterior synovial membrane is so largely implicated, that Chopart's amputation must be had recourse to.

The mode of proceeding, however, should depend upon the seat of disease; when the mischief commences in the tarso-metatarsal articulation, and attacks the bones secondarily, as in the case related in the Second Lecture, it is better to amputate as in that case, viz., through the cuneiform and cuboid bones themselves; when, on the other hand, the disease originates in the cuneiform bones themselves, the amputation should be performed at the scapho-cuneiform articulation, the entire cuneiform bones being removed, and the cuboid cut across with the saw. If the disease has extended through the joint to the anterior surface of the scaphoid, it will in most instances be sufficient to remove a thin slice of the scaphoid with a saw; but in all cases where practicable, for the reasons I have stated when treating of Chopart's amputation, it is most important that the scaphoid bone should be preserved. As far as my experience serves me, partial removal of the cuneiform bones by the gouge is by no means a successful proceeding. In the year 1853 I gouged away the carious portion of the internal cuneiform bone of a young man, aged twenty-one, but the case did so badly, I was obliged to remove that portion of the foot in front of the scaphoid bone; and the patient recovered with a most useful stump, being able to walk about with the greatest freedom and with scarcely any limp.

In 1845, Mr. Rayner, of Stockport, excised the three cuneiform bones from the foot of G. H——, aged sixteen, for caries. The operation was partially successful, but the patient died some months afterwards of disease of his lungs. Textor senior, removed the anterior half of the internal cuneiform bone for caries, and the patient recovered. Saviard removed the whole of the internal cuneiform bone for necrosis and Malconi, extirpated the internal and middle, but with what result is not stated. De Lamotte excised the external cuneiform bone for gun-shot wound, with good results; and I am indebted to the kindness of Mr. Joseph Walker, of Burslem, Staffordshire, for the account of the following interesting case of—

Dislocation of the Middle and External Cuneiform Bones.—Removal by Operation.—Recovery with a Sound Foot.

A boy, aged fourteen, was admitted into the North Staffordshire Infirmary, under the care of Mr. Walker, on March 14, 1865. He had been leading a horse which was drawing a heavy railway waggon, and catching his foot in a crossing-box, the waggon ran over it. There were two lacerated wounds of the leg and an extensive one of the heel and sole of the foot; and over the instep, at a point corresponding to the scaphoid bone, was a rounded, hard prominence, measuring one and a-half inch antero posteriorly and an inch transversely, the skin over it being very tense. There appeared to be a sharp edge with a rounded upper surface; in fact, it felt like the scaphoid bone. An attempt was made to reduce the dislocated bones, and this failing, chloroform was given, and an incision made over the prominent part. The two external cuneiform bones were found lying upon the scaphoid bone, with their metatarsal articular surfaces upwards. They were easily removed by a few touches with the knife, and the wound was closed by wire sutures. Owing to the severely crushed state of the heel and sole of the foot the wounds were long in healing completely, and free suppuration occurred. On May 10th, the patient was allowed to walk with crutches, the wound on the instep being quite well, a slight depression still existing where the cuneiform bones had been. On June 15th, he left the infirmary, the ankle being still rather stiff, but able to bear considerable weight. When last seen as an out-patient he could use the foot very comfortably.

Mr. Nunneley of Leeds, removed the internal cuneiform bone and the great toe successfully.

Mr. Wright, of Cheltenham, has frequently disarticulated the first and second cuneiform with the corresponding metatarsal bones. He says these operations have answered very well, and the patients are now living, having very useful feet, much more so than could have been supposed.

On the 4th February, 1845, M. C——, aged twenty-one, received a severe injury to his foot and leg, whilst following his occupation as a fireman on the railway; a fortnight afterwards, Dr. Jackson, of Darlington, removed the internal cuneiform and four metatarsal bones, leaving the toes intact. The patient recovered with a very useful foot.

The case of Mr. Hey, of Leeds, has been related in Lecture II.

Lesfiane disarticulated the two internal cuneiform and metatarsal bones. Considerable inflammation ensued, but the patient did well.

Rayer removed the two internal cuneiform bones with only the first metatarsal bone. The patient recovered and walked without lameness.

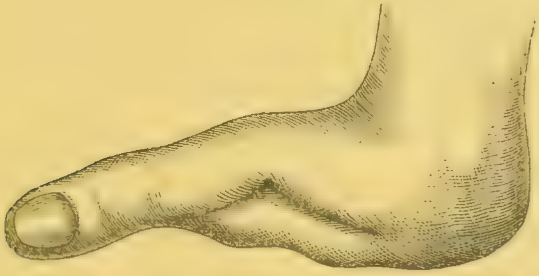
Jobert amputated the three cuneiform and all the metatarsal bones. Ten months afterwards the patient could place his foot flat on the ground, but could not walk.

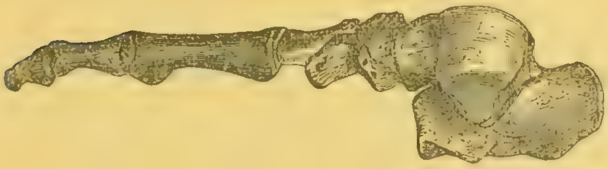
In November, 1868, my friend and colleague, Mr. Fairlie Clarke, disarticulated the three cuneiform bones from the scaphoid, and sawed off the projecting extremity of the cuboid bone, in a man, aged sixty-one, and the man recovered.

Resection of the Four External Toes with the corresponding Metatarsal and External Cuneiform and Cuboid Bones.

Case 1.—Mr. Gay performed this operation on a man, for accident. The operation, he says, was followed by considerable abduction of the great toe, but the man made a capital recovery, and when last seen by Mr. Gay could walk almost as well on that as on the other foot.

Through the kindness of Mr. Gay, I am enabled to subjoin two wood-cuts, showing the appearance of the stump when applied on the ground, and also the bones preserved.





Case 2.—Mr. Moore (*Medical Times*, 1857, vol. i., p. 312), in the year 1856, removed the four outer toes with the corresponding four metatarsal, the external cuneiform and cuboid bones, for an injury.

The soft parts were so much injured that the cure was tedious, but the patient ultimately walked with a very slight limp, and as quickly as any other person.

Case 3.—Mr. Wordsworth performed a similar operation at the London Hospital, and with similar results.

Complete Resection of Metatarsal Bones.

In 1795 Barbier removed the first metatarsal bone, which had been dislocated and could not be reduced. Beaufils, who published the case in 1797, reports that the patient was cured in forty days.

Baron Larrey also performed this operation for irreducible dislocation with equal success. It has also been performed for caries by Bell, Petrequin, Blandin, Velpeau, Lisfranc, Roux, &c.

The celebrated Hey, of Leeds, observed, "When caries is confined to a portion of the first metatarsal bone, it is usual to remove the part with a saw after making a crucial incision; but as it is difficult to recognise the exact extent of mischief, it is, I think, better to separate the whole of the bone from its articulation with the internal cuneiform;" and for this purpose, "cut the soft parts from the scaphoid bone to the dorsum of the first phalanx, separate the edges of the wound, and draw the extensor tendons on one side; disengage, luxate, and draw out the head of the metatarsal bone, which bone isolate from the soft parts, and lastly separate it posteriorly from the cuneiform bone.

Roux recommends the incision to be made thus ⊣, Champion thus H; but after all the surgeon must be guided by the nature of the case.

Mr. Hilton, in September, 1858, cut down upon the first metatarsal bone of a lad, and removed it entire. The result of the operation is not given.

Mr. Benfield, of Leicester, excised the metatarsal bone of the great toe for necrosis in June, 1865. The patient made a good cure, with a useful foot.

Again in February, 1866, he operated upon a man, aged 66, and excised the metatarsal bone of the left great toe for caries. The wound appeared to suppurate healthily, but on the fourth day the patient was attacked by shivering, followed by abscess of his right elbow and general acute pyæmia, and died a few days after the operation.

Mr. Sampson, of Southampton, removed the metatarsal bone of the great toe from a girl aged twelve years, for caries of several months' duration, with sinuses on the dorsum of the foot leading to the diseased bone.

The girl made a good recovery, and at the age of sixteen had a perfectly sound and healthy foot, and was actively engaged as a nurse, and had not the slightest appearance of lameness in walking.

I have upon two occasions removed the metatarsal bone of the great toe, and with success. Upon one occasion I carefully preserved the periosteum, and when the patient left the hospital there was much less shortening of the inner side of the foot than usually obtains after this operation, and a new bone was in process of formation.

Other metatarsal bones besides that of the great toe occasionally require removal.

Mr. Barnard Ring, Stratford-on-Avon, for instance, excised the fifth metatarsal bone of the right foot of a girl aged twenty. She had been lame for five years, and was only able to move about the house with the aid of a stick, and one or two openings led to bare bone. She was subsequently able to walk several miles at a time without difficulty.

Mr. Jackson, Darlington, in Feb. 1845, removed four metatarsal bones, preserving the toes intact. The patient recovered, and was able to walk well.

Mr. Moore was much satisfied with the result of an operation he performed in February, 1856, for the removal of the four external metatarsal bones for a gunshot injury. The first metatarsal bone maintained much of the firmness of the foot, and the patient (a man) walked without limping.

Partial Resection of Metatarsal Bones.

The elder Moreau, in 1788, removed the base of the fourth metatarsal bone for caries.

In 1822 Textor removed the head of the fifth metatarsal bone for caries; in 1826 Kramer the head of the first metatarsal bone for dislocation. In 1828 Graefe extirpated a portion of the first metatarsal bone; and in 1829 Roux performed partial resection of metatarsal bones three times. The operation has also been performed by Jope, Blandin, Jobert, and Heister, all with success.

Mr. Tudor, of Dorchester, has favoured me with the following case:—

A sailor, aged twenty-seven, was admitted on board the *Dreadnought* on 4th January, 1859. Three months previously he had felt pain in the left foot over the fifth metatarsal bone. The parts inflamed, swelled, and suppurated. He had never received any injury, but as steward of his ship had much walking. On admission there were two sinuses communicating with dead bone. An incision three inches long was made in the course of the bone, and the whole anterior surface which was found necrosed, with the exception of the articular surfaces, was removed. The wound gradually closed up, and in rather less than two months the patient was able to walk about without inconvenience.

Mr. Birkett in 1857 removed the distal half of the first metatarsal bone from the epiphysis without opening the joint. The patient, a girl aged eight years, recovered completely, with very little shortening of the toe.

Mr. Herbert Budd, Worcester, in 1865 excised the posterior extremity of the first metatarsal bone from a married woman, for caries. He left the metatarso-phalangeal articulation intact. The patient recovered.

Resection of Metatarso-Phalangeal Articulation.

This operation was first performed by Professor Pancoast, of America, subsequently by Professor Rignoli, of Pisa, and twice successfully by Fucke.

Champion twice resected the posterior extremity of the first phalanx of the great toe in a state of caries, and in both instances the patients completely recovered.

Strongly advocated by the late Mr. Liston, this operation has on various occasions been performed in the United Kingdom.

Resection of the Metatarso-Phalangeal Joint of the Great Toe.

Mr. Hilton, on the 10th August, 1852, performed this operation upon a farm labourer, aged twenty-seven, for inflammatory disorganization of several months' duration. An abscess formed afterwards, and some spiculæ of bone subsequently worked out; but eventually the wound healed, and the man was able to resume his work.

In the *Dublin Journal* for 1859 we read that Mr. Butcher excised the metatarso-phalangeal joint of a strumous girl, aged eighteen, for caries. Mr. Butcher removed the ends of the bones with bone cutters, and divided the extensor tendon, "to prevent the cocking up of the great toe's unguinal phalanx." The operation was performed on the 6th November, 1857, and six weeks after the wound had entirely healed, and she was able to return to her duties as a lady's maid. Months afterwards Mr. Butcher reports that she moves about without inconvenience. The only disfigurement was the diminished length of the toe. The intervening tissue between the cut surfaces of the first phalanx and metatarsal bones was fibrous, and so dense as to be almost cartilaginous.

A man aged fifty-seven was admitted into Guy's Hospital under the care of Mr. Bryant on July 4, 1860, with disease of the metatarso-phalangeal joint of the left great toe, of many months' duration.

On July 9 Mr. Bryant excised the joint. Rapid recovery followed, the parts being firmly ankylosed when he left the Hospital.

Mr. O'Doherty, surgeon to St. Vincent's Hospital, resected the distal extremity of the fifth metatarsal bone and the whole of the phalanx. On the tenth day after the wound had healed by first intention, excepting that portion occupied by a sinus. This sinus continued to discharge for a considerable period, but ultimately got well, and the patient, a girl aged sixteen, could run about as well as ever, as the sole of the foot having been left intact, and its breadth unimpaired, the foot remained a perfect organ of support.

A mechanic, aged fourteen years, residing at Worthing, was admitted into the Leeds infirmary on the 14th May, 1865, under the care of Mr. Wheelhouse.

About a month before admission an abscess had formed in front of the metatarso-phalangeal joint, which did not heal up, but continued to discharge a little pus.

On admission a fistulous opening was seen in front of the joint, through which a probe was passed, when necrosed bone could be distinctly felt at the bottom of the sinus.

May 25th.—Excision of the joint was performed, and half the metatarsal bone of the great toe was removed.

Considerable pain followed the operation, and continued for several days; but the wound healed in sixteen days, and he was discharged cured.

Mr. Herbert Budd, of Worcester, excised the first metatarso-phalangeal joint of a man, aged sixty, with success.

This operation is not restricted to the great toe, but it is equally applicable to the metatarso-phalangeal joints of other toes.

H. H——, aged twenty-four, was admitted under my care into the Charing Cross Hospital, December 20, 1866, with a wound on the dorsum of the foot corresponding to the second metatarsal bone.

His attention was first drawn to the part in April by a painful swelling appearing in that situation. He has been since then under treatment at various hospitals.

When admitted there was a wound on the dorsum of the foot corresponding to the metatarso-phalangeal joint of the second toe, and discharging a quantity of offensive fœtid matter, and a probe introduced into the wound disclosed the presence of diseased bone. On the 12th January, 1867, I cut down and excised the joint. The resulting cavity filled up but slowly, but the man ultimately did well, and was discharged at the expiration of four months.

Resection of the Phalanges of the Toes.

Probably in no instance has the progress of conservative surgery been better exemplified than by the introduction of this operation.

In the year 1863 Mr Burford Norman, of Southsea, in a case of necrosis growing from the distal phalanx of the great toe of a lad, instead of amputating the toe at the joint behind the nail, dissected the integuments, nail included, away from the phalanx, and cut the latter through by forceps behind the seat of exostosis.

The disease had existed for three years, and protruded at one point through the nail, causing great pain and inconvenience. The patient recovered completely, and in February, 1866, Mr. Norman writes me, "I have to-day seen this patient with a good toe and a good nail."

Mr. W. Dunnett Spanton, Hanley, kindly informs me: "There is a patient now in the North Staffordshire Infirmary who had compound fracture of the first phalanx of the great toe. I removed the entire phalanx, and now, a week afterwards, the part has contracted so that the bone of the second phalanx articulates with the head of the metatarsal bone, and there is no perceptible deformity.

Sir Henry Thompson removed the proximate phalanx of the great toe in a girl who made a rapid and excellent recovery.

Resection of the Sesamoid Bones.

This, I believe, has never been performed except by Mr. Hilton, who upon two occasions cut down upon and removed the sesamoid bones, obtaining ankylosis of the diseased joints.

Amputation of Foot through the Metatarsal Bones.

Although commonly described as Hey's amputation, this was first performed in this country by Mr. Turner, junior, of Yarmouth, in the year 1787, at the instigation of Dr. Aikin of that town. Mr. Hey may subsequently have adopted this proceeding, but he did not originate it. The operation which he published in 1799 was one of a different and much more difficult nature, viz., "Disarticulation of the front of the foot at the tarso-metatarsal articulations."

In October, 1787, Mary Sloman, aged twenty-three years, consulted Mr. Turner, junior, of Yarmouth, for a considerable tumour upon the top of her foot. It began about two years before by a small and immoveable swelling on the second metatarsal bone, near to the joint of the toe, and gradually increased in size till its dimensions were as follows: transversely it measured four inches and a half and longitudinally the same, and three inches thick.

The tumour, of stony hardness and immoveable, was firmly attached to the four internal toes, and reached about half way up the metatarsus, causing great pain. The foot was entirely useless.

In consultation it was thought hard for the patient to lose her leg at the usual place below the knee, and it was agreed that as much of the foot should be saved as could be, after completely removing the tumour and the parts connected with it.

On the 8th of October, 1787, Mr. Turner performed the operation by the double flap. The foot was sawn through at the posterior part of the metatarsus, and the hæmorrhage was easily suppressed.

The stump had completely healed on the 18th December. Mr. Turner adds, with great fairness, "The idea of operating in the middle of the foot was suggested by Dr. Aikin of this town (Yarmouth), and he has the merit of all the advantages the woman will certainly derive from the operation having been performed at that part."

The credit consequently of suggesting this proceeding is due to Dr. Aikin, and of first performing it to Mr. Turner, of Yarmouth.

This operation is so simple, and has been attended with such good results, that it is now generally dopted in appropriate cases.

Amputation of the Toes,

Often required for accident or disease, is too frequently rendered necessary by bad management of the feet in infancy and childhood. I would consequently direct attention to four small works upon this subject, which cannot be too carefully studied. The first is entitled, "Our Feet and their Coverings," from the pen of W. H. Flower, F.R.S., the distinguished conservator of the Museum of the Royal College of Surgeons. The second, or "The Human Foot and the Human Hand," is by the learned Professor of Human Anatomy at Cambridge (Professor Humphry.) The third, or "Why the Shoe Pinches," is by Professor Herman Meyer, of Zurich; whilst the fourth, "The Foot and its Coverings," is a translation of Camper's work "On the Best Form of the Shoe," published by Mr. Dowie.

The subject has been so ably treated in these monographs that, even if space permitted, it would be a work of supererogation for me to enlarge upon it here; I will therefore only observe, that the mischief of which we complain is not so much the result of maltreatment of the adult, as of mismanagement of the young; and therefore improvement should commence in the nursery as well as in the shoemaker's shop. The foot of the infant is too frequently thrust into ill-made elastic worsted socks, so much too short that the foot is converted into a last to stretch the fabric to its required length. We have seen how delicate and complicated is the organization of the metatarso-phalangeal joint of the great toe of an infant, and how easily it may be diverted from its proper direction. We all know how painful it is even to an adult to wear a stocking of insufficient length. How much more painful must it be to an infant, and how much more certainly must the pressure act upon these joints and establish that deformity necessitating operative interference. Again, a child's shoe rarely affords sufficient length and space for the free play of its toes; a shoe may appear to be half-an-inch or more too long, and yet in reality so much too short as to cause pressure and distortion. This arises from ignorance on the part of the last-maker as to the true shape of the toes. A last is always tapered off at its anterior extremity, so that its thinnest portion is that which corresponds to the tips of the toes, where, in fact, the toes are clubbed and considerably thicker than at any other part. This, of course, tends to the neat appearance of the shoe, but militates greatly against the due development and well-doing of the foot.

Amputation of the toes has frequently been performed for accident, disease, and deformity.

W. J——, aged nineteen, had his four inner toes crushed by machinery, the little toe alone escaping.

He was taken to the North Staffordshire Infirmary, where Mr. Folker removed the entire row of toes, as he considered that the little toe, although uninjured, would, if left, have been much in the way.

Mr. Hunter, of Margate, September 2, 1864, removed the great toe and corresponding metatarsal bone of the left foot from a man, aged twenty-one. The patient was discharged cured fifty-three days after the operation; also, July 15, 1864, the great toe and the corresponding metatarsal bone of right foot of a girl, aged fifteen. The patient was discharged cured.

This operation has also been performed by Messrs. Flint, Meade, and other surgeons, for caries and necrosis.

Mr. O'Doherty, St. Vincent's Hospital, Dublin, removed the second metatarsal bone with its toe. He says (*Dublin Quarterly*, 1859): "I found it more difficult than I expected to separate its posterior extremity. The hæmorrhage was copious, the communicans tibialis artery and internal plantar having been wounded. The operation was followed by severe inflammation and suppuration, but the patient ultimately recovered, and six months after walked as well as ever."

Towards the latter end of last year, 1867, I removed both the great toes of a gentleman, above fifty years of age, who came from abroad for the purpose of having the operation performed. The toes in question were so distorted that they were twisted across the backs of the neighbouring toes, rendering walking extremely painful and difficult. In both feet I made an upper and a lower flap, and cut through the front of the metatarsal bone obliquely from before backwards and outwards, thus affording a bevelled surface, and doing away with the abrupt projection which would otherwise have been formed by the head of the metatarsal bone. Ligatures were applied to the arteries, and the flaps brought together by sutures.

Intense pain and severe inflammation ensued in both feet with implication of the absorbents, so that for some days his condition caused me considerable anxiety. He ultimately, however, did remarkably well, and at the end of ten weeks was able to wear an ordinary pair of boots, and to walk so entirely withovt limping, that no one would suppose he had undergone anything of the kind.

If I should ever be called upon again to perform this operation, I would rely upon strips of wet lint to keep the flaps together, instead of employing sutures. The patient complained so greatly of the intense agony and tension caused by the latter, and the relief experienced by their severance was so manifest, that I am convinced they did more harm than good, inflicting unnecessary torture without effecting the slightest benefit. When cut through, the wound gaped as much as at the time of operation, but it gradually closed in; whilst the employment of the carbolic acid effectually prevented any undue suppuration, and as we have seen, the patient was well in a comparatively short time.

Resection of the Front of the Foot at the Tarso-Metatarsal Joints, or Hey's Operation.

"In the year 1797," writes Mr. Hey, "a case occurred that led me to a new mode of operating, which, upon repeated trial, has fully answered my expectations. Mary Sedgwick, of Otley, aged eighteen years, was brought to the Leeds Infirmary, on account of an ulcer on the upper part of the foot, at the root of the first and second toes. Upon examination I found the metatarsal bones carious, and determined to remove the three first metatarsal bones and so much of the smaller bones of the tarsus as were covered with diseased integuments; but upon sawing the metatarsal bones, they were found to be so soft that they might easily be cut with a knife. I did not think it prudent to leave any portion of bone that was in so diseased a state; consequently, I removed the greatest part of the cuboid bone with a small portion of the astragalus. The extent of disease in the metatarsus and tarsus put me under the necessity of removing all the toes, which were now rendered useless, and suggested a method of finishing the operation, which proved highly advantageous to the patient. Having dissected out the metatarsal bones, and removed the toes by a transverse incision made at their junction with the metatarsal bones, I elevated the integuments and muscles forming the sole of the foot, and applied their extreme edge (where I had cut off the toes) to the edge of the wound made through the integuments and muscles on the upper part of the foot. The parts were retained in contact by sutures."

This, it will be seen, was a much more difficult and complicated operation than that originated by Turner, twelve years before, of sawing across the metatarsal bones: it also shows that Mr. Hey, even at that date, did not participate in the dread of sawing through the spongy tarsal bones.

"In the year 1799," continues Mr. Hey, "I had the opportunity of repeating this operation, and found it to answer perfectly my expectations.

"I made a mark across the upper part of the foot to point out as exactly as I could the place where the metatarsal bones were joined to those of the tarsus. About half-an-inch nearer the toes I made a transverse incision through the integuments and muscles covering the metatarsal bones. From each extremity of this wound I made an incision (along the inner and outer side of the foot) to the toes. I removed all the toes at their junction with the metatarsal bones, and then separated the integuments and muscles forming the sole of the foot from the inferior part of the metatarsal bones. . . . I then separated with the scalpel the four smaller metatarsal bones at their junction with the tarsus, which was easily effected, as the joints lie in a straight line across the foot. The projecting part of the first cuneiform bone, which supports the great toe, I was obliged to divide with a saw."

Baron Larrey, to facilitate the performance of this operation, in his "Clinical Surgery," 1829, draws attention to the projections of the fifth metatarsal bone on the outside, and of the internal cuneiform bone on the inside of the foot, and recommends the lower flap to be made some lines longer than the upper; whilst Mr. South observes (Chelius, p. 951): "If the projection of the fifth metatarsal bone cannot be properly made out, a point two inches before and below the outer ankle will sufficiently distinguish it. The projection on the first metatarsal bone, if it cannot be felt, will be found nine lines below a line supposed to be drawn from the prominence of the fifth metatarsal bone directly to the inside of the foot."

I am indebted to the kindness of Mr. C. Williams, of Norwich, for the following case:—

A man, aged twenty-eight, suffered from a round jagged ulcer on the sole of his right foot, from which sinuses led to various metatarsal bones, which were felt to be denuded of periosteum. Having been under treatment for a long time, without deriving much benefit, he, in June, 1861, entered the Norfolk and Norwich Hospital, under the care of Mr. Frith.

Mr. Frith removed the metatarsus by Hey's operation. The wound healed by first intention, and the patient was able to walk uncommonly well.

Sir William Fergusson (*Lancet*, 1857, vol. i., p. 165) performed Hey's operation upon an elderly woman, for an ulcer on the dorsum of the foot, which would not heal. The patient recovered with an excellent stump.

J. B——, a labourer, aged twenty-two, was admitted into St. Thomas's Hospital, under the care of Mr. Le Gros Clark, on the 10th August, 1865, for an accident, in which the four inner toes of his left foot were crushed. Mr. Clark removed the toes at the tarso-metatarsal joints. Some suppuration ensued, but he left the hospital well, fifty-three days after his admission.

The present distinguished surgeon of the Leeds Infirmary has also honorably connected his name with the tarso-metatarsal articulation by the following case, for which I am indebted to his liberality and kindness.

Removal of the Anterior Part of the Foot at the Tarso-Metatarsal Articulation by Lateral Flaps, by Samuel Hey, of Leeds.

S. A. B——, aged eighteen, a thin delicate girl, came to the Leeds Infirmary, at the beginning of July, 1865, on account of an enchondroma of the left foot, affecting or situated on the second and third metatarsal bones.

It commenced four years before, and slowly increased in size. The skin over it was natural. Its size was two inches from side to side by one and a-half inches in length, as viewed from the dorsum of the foot, appearing below to overlap the first metatarsal bone, though from the thickness of its coverings, it was difficult to judge of its precise extent. In form it was irregularly nodulated. In consistence hard and obscurely elastic. Painless on pressure.

The case came in for operation on December 28, 1865. Various opinions were given as to the best mode of operation, so as to ensure the removal of the whole of the disease; but it appeared to me that none could be satisfactory short of removing the whole of the front part of the foot. An incision was made along the dorsum of the foot, and carried round each side of it, skirting the edge of the tumour so as to save all the sound skin, and forming two lateral flaps uniting behind the posterior part of the tumour in the sole of the foot, at a point opposite the commencement of the incision on the dorsum. This avoided the skin stretched over the plantar aspect. The knife was then carried behind the three external metatarsal bones, the ligaments of the fourth being next divided, and the internal cuneiform bone cut across with a strong knife. The flaps were abundant, and formed a most satisfactory stump. They were united by wire sutures, and healed almost entirely by first intention.

The result is perfectly satisfactory. The covering of the stump is abundant; and with an ordinary with an ordinary shoe the patient, six months after the operation, can walk so entirely without limp, that no one can say which is the deficient foot.

The only remark to be made is, that an operation so successful in a special case may possibly be useful when election is open.

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